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MISSOURI BOTANICAL GARDEN BULLETIN

VOLUME IX

WITH 32 PLATES

1921

ST. LOUIS, MISSOURI

PUBLISHED MONTHLY, EXCEPT JULY AND AUGUST,
BY THE BOARD OF TRUSTEES

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OF THE MISSOURI BOTANICAL GARDEN

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HENRY SHAW, 1835.

Missouri Botanical Garden Bulletin

Vol. IX St. Louis, Mo., January, 1921 No. 1

THIRTY-SECOND ANNUAL REPORT OF THE DIRECTOR

Gentlemen:

I have the honor to submit herewith the thirty-second annual report of the Director.

The same financial difficulties experienced in 1919 in the administration of the Garden were, to an increased degree, encountered during the past year. Even after the war a legitimate excuse existed for a time for failing to keep up to former standards the various features for which the Missouri Botanical Garden has become famous. During this period it was possible to reduce the force, eliminate flower shows, neglect outside gardens, and practice other economies which released money for the rapidly increasing cost of labor and supplies. During 1920, however, it became necessary at least to bring the various activities of the Garden back to a maintenance basis, since things which could safely be neglected for three or four years had to receive attention unless they were to be abandoned altogether. That the community and the country at large demand more of the Missouri Botanical Garden than they did ten years ago is a matter of common knowledge. Its activity in the scientific and garden world has placed it in the front rank of similar institutions, and it would be extremely unfortunate if, because of financial limitations, the Garden were forced to take a secondary position. As is well known, endowed institutions throughout the country have found it necessary to increase very materially their sources of income, whereas the Missouri Botanical Garden during 1920 had less available for Garden maintenance than it had five years ago. It is true that the able management of the estate has increased the gross income of the Garden during this period, but the increase was more than absorbed by the necessary expenses involved in extra taxes and the maintenance of the estate. There has likewise been in this period a serious loss to the income, due to the gradual running out of the clay mines, the royalties from which formerly furnished a substantial amount.

Mr. Shaw, anticipating that the Garden would require a gradually increasing amount for its maintenance, reserved a strip of land two hundred feet wide around Tower Grove Park and stipulated that the gross income from the leasing of this land for residential purposes should come to the Missouri Botanical Garden. With the exception of a few thousand dollars obtained years ago from market gardeners, no revenue has ever accrued to the Garden from this source. Repeated attempts to obtain an adequate rental from the city for the ground for park purposes have thus far resulted in nothing. More than six years ago the Supreme Court of Missouri rendered a decision requiring the city to make leases and turn the revenue received therefrom over to the Trustees of the Garden, but as yet nothing has been obtained from this source. It is unfortunate that, since the Garden now has practically no other means for obtaining the money necessary to maintain its present standard, the failure to carry out the plan as devised by Mr. Shaw will necessitate a serious curtailment of the activities of the Garden. Important and necessary improvements, including the development of about half the land set apart by Mr. Shaw for Garden purposes, an entrance into the Garden from Kingshighway, and other plans long contemplated, will have to await the final disposition of the two-hundred-foot strip problem.

Construction of Fence and New Entrance.—In spite of the lack of funds, two fundamental improvements, long contemplated, were at the beginning of 1920 recognized as being absolutely necessary and accordingly an order from the court was obtained, granting the authority to borrow the money needed. I refer to the construction of a permanent fence around the unfenced portions of the Garden and the reconstruction of the gateway at the main entrance to the Garden.

Several years ago an iron fence was constructed along that part of the Garden fronting on Magnolia and Alfred Avenues, but the land extending along Shenandoah to Kingshighway and from Kingshighway along Vandeventer and Shaw Avenues up to the engineer's house on Shaw Avenue has remained practically unfenced. The increasing vandalism and damage done by mischievous boys, due in part to the absence of a fence, made it necessary, if the Garden were to be preserved intact, that some adequate barrier should be erected along this part of the Garden. Even had it been possible to satisfactorily police this area, the expense involved would have been considerably more than the annual interest on the

HENRY SHAW, 1850.

HENRY SHAW, ABOUT 1865.

investment for a permanent fence, and accordingly in the spring of this year approximately 6000 feet of galvanized steel and wire fencing, surmounted with three strands of barbed wire, was erected. It also seemed desirable to add three strands of barbed wire to the fence along Magnolia and Alfred Avenues, and the Garden is at last enclosed in a manner calculated to protect it in as adequate a way as possible.

The main entrance to the Garden was erected by Mr. Shaw in 1858. While sufficient for all purposes during his lifetime, this structure, with its accompanying rooms for office and toilet purposes, has long been outgrown. The main axis of Flora Boulevard, which was put through after the erection of the gate, was some forty feet off from the center of the gate and has obviously needed correction for years. This, however, was a very minor matter compared to the inadequate space for handling the large incoming and outgoing crowds at the entrance and the inconvenience to which the increasing number of visitors have been put during recent years because of the lack of proper toilet facilities. When it is realized that as many people visited the Garden during the chrysanthemum show last year as in an entire twelve months during Mr. Shaw's lifetime and for some years afterwards, it is easy to appreciate the difficulties with which we have had to contend. It is safe to say that for the past ten years no one thing at the Garden has been so universally criticised —even being the subject of newspaper editorial comment— as the conditions at the main entrance, and, while the Board was loath to incur the extra expense at this time, it seemed as though this improvement could not be longer delayed if the Garden were to continue to be kept freely open to the public. Accordingly, plans were prepared which followed almost exactly those of the original gate, with the exception that the size of the entrance and accompanying buildings was increased about two and one-half times. The old inscription prepared by Mr. Shaw is to be incorporated in the new gate and every effort made to preserve the same simple architectural features by which the original gate was characterized. While, for a time at least, the contrast between the evident newness of the new entrance and the old brick and iron and stone gateway which had to be frequently painted will be noticeable, the proper use of vines and accompanying planting, together with the weathering of the stone, will within a comparatively short time blend this structure into its surroundings in the same admirable way that the old gateway

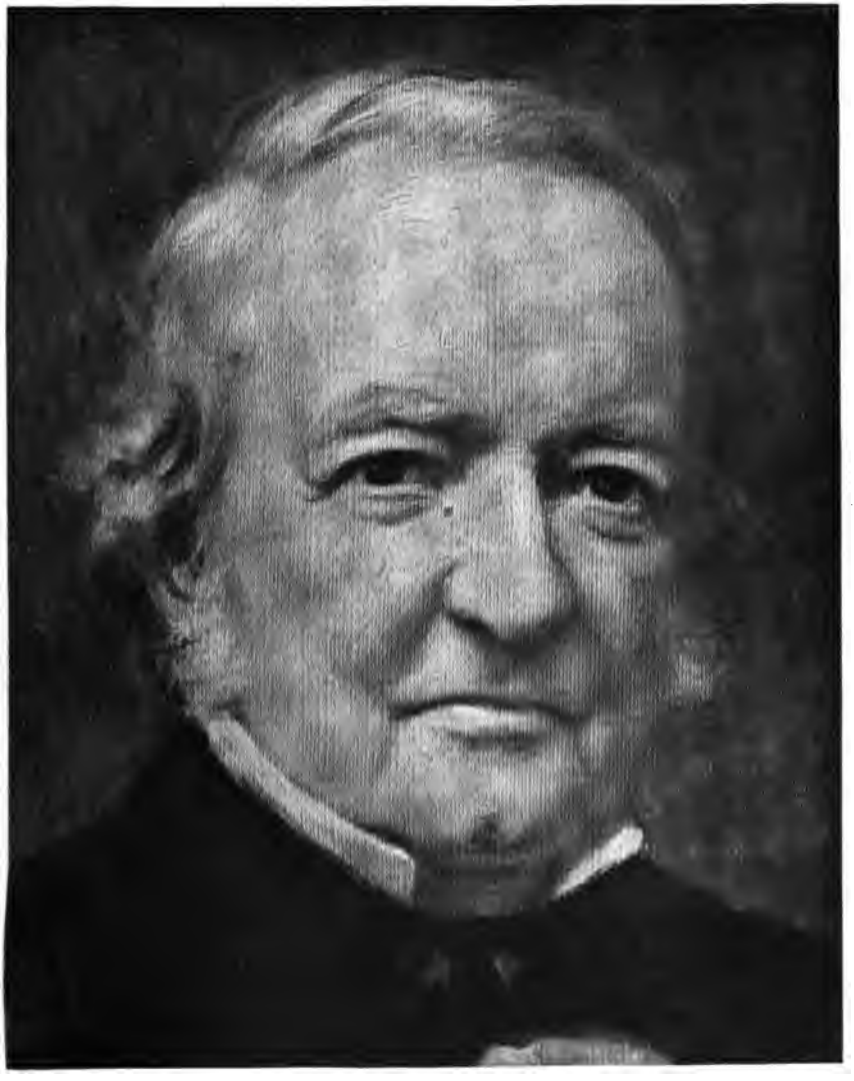
fitted into the landscape. In any case it is believed that the increased facilities now afforded for the comfort of visitors to the Garden more than offset any temporary loss due to the new, but not modern, appearance of the gate. The construction of the new entrance was begun on April 1, and although much delay was occasioned by strikes and inability to get necessary materials, the north wing, containing toilets for men and women, was ready for use on November 15. It is hoped that the entire edifice will be completed early in 1921.

New Propagating and Growing Houses.—The new range of propagating and growing houses was begun in 1919 and completed, in so far as the erection of the two additional houses was concerned, during 1920. Some of the benches remained to be added, as well as certain other minor concrete work, such as pipe trenches, steps, etc. No start was made towards the erection of the head house, for which the foundations were poured in 1919. During the summer the old range of greenhouses, which these new houses were erected to replace, was wrecked and as a consequence this part of the land back of the wall presents a much more settled appearance.

Additional Construction and Repair Work.—In pursuance of the plan, adopted several years ago, to include as rapidly as possible all the heating pipes in a tunnel to which access may be had at any time, the short strip of about a hundred feet from the valve chamber to the manhole near the office building was constructed this summer. When the old pipe was removed it was found to be in very bad condition and much of it had to be replaced.

During the summer the roofs of the palm house, economic house, fern house, and floral display house had to be repainted and reglazed with one of the newer substitutes for putty, and as a consequence the loss from breaking of glass during windstorms has been much reduced. While the time of two painters has been steadily employed throughout the year in glazing and painting, it has not been possible to accomplish all in this way that was desired and special attention will have to be paid during the coming year to painting, if the woodwork, both inside and outside, of our various houses is not allowed to deteriorate.

Planting.—In addition to maintaining the usual outdoor collections and special gardens, including the replanting of the Italian garden, considerable time and attention has been given to improving the arrangement and appearance of all outdoor collections. The erection of a permanent fence along Shaw



HENRY SHAW, ABOUT 1870.

HENRY SHAW, 1873.

Avenue made it possible for the first time to improve the Garden at this point. Some 2,300 shrubs and small trees, together with several thousand iris plants, were used in forming a border inside the fence and the vastly improved appearance along Shaw Avenue, which has now become such an important thoroughfare, has been frequently remarked upon. The knolls have been almost completely replanted, at least so far as hardy perennials are concerned, and it is believed that the regrouping of blooming material in this part of the Garden will considerably enhance the view from the main walks. Considerable replanting was, as usual, necessary in the rose garden, and the nursery stock has been replenished to fill in the gaps made by the heavy drafts on this material for replacement purposes throughout the Garden.

The test garden, which was so successful in 1919, was again maintained during 1920. The interest in this collection of supposed novelties and new plants for St. Louis is increasing, and, as noted in the October, 1920, number of the BULLETIN, where a full account of the garden is given, several new things were grown which it seems worth while to perpetuate in the Garden.

The wild flower garden, back of the pergola, has been considerably enlarged and improved, and in addition to the usual care of the lawns, fertilizing, reseeding, etc., a considerable number of hardy bulbs were planted here last fall. The majority of these, including the narcissus, crocus, scillas, etc., were incorporated in the arboretum, but a number were likewise placed in various parts of the lawn throughout the Garden.

Spring Flower Show.—On Saturday, Sunday, and Monday, May 14, 15, and 16, the Garden Club of St. Louis held its first flower show in the floral display house, and a very creditable display was made by both commercial and amateur growers. It is hoped that this show, which will probably be an annual event, will help to create a greater interest locally in the growing of plants, as well as fruits and vegetables. The floral display house was lighted for the first time, and, although the weather was not at all favorable, there was an attendance of over 10,000. The Garden, in addition to contributing the house and much of the labor involved in installing and caring for the exhibits, likewise offered $500 in prizes.

Another unusual event held in the floral display house was the annual gardeners' banquet, given on the occasion of the

meeting of the National Association of Gardeners in St. Louis on September 15. Some two hundred were in attendance and Dr. von Schrenk, Pathologist to the Garden, gave an illustrated talk on "Trees of the Pacific Coast." An interesting event in connection with the meeting of the National Association of Gardeners was the presentation of a gold medal to Mr. George H. Pring, Horticulturist to the Garden, for the creation of the magnificent new water-lily, "Mrs. Edwards Whitaker." This was the second time that a gold medal had been awarded by the Association.

Vocational Training for Ex-Soldiers, and School for Gardening.—The work begun last year of providing special instruction in gardening for soldiers has been continued. In addition to the opportunities for practical work there have been offered special courses of lectures in plant materials, horticulture, water gardens, and other subjects calculated to be of essential importance. During the year there have been eleven men placed at the Garden by the Federal Board for Vocational Education, and, with one or two exceptions, all the students have given earnest and conscientious attention to the work. The fact that each man had to be treated individually, either because of the difference in training and experience or the particular line of work he intended to pursue after leaving the Garden, has made it necessary to depart entirely from the course as laid down for the School for Gardening. It is hoped that by another year, with new vocational students and new pupils entering the School for Gardening, a combination may be effected which will make unnecessary this duplication of work. During the year Mr. James Monteith satisfactorily completed his work in the School for Gardening, and since September 1 has been landscape architect at the Glen Echo Country Club. Miss Virginia McMath and Mr. Robert Mitchell have started on their third and last year in the school.

ATTENDANCE FOR THE YEAR 1920

The reconstruction of the main gate, together with the extraordinarily large crowds on certain Sundays, has made it impossible to keep as accurate an account of the visitors as in former years. The attendance as listed below, although an increase of thirty per cent over last year, is certainly less than the actual number of visitors who came to the Garden, but is as fair an estimate as could be obtained under existing conditions. With the completion of the new entrance and

HENRY SHAW, ABOUT 1884.

HENRY SHAW, 1885.

the installation of registering turnstiles, it will be possible to record the attendance with more accuracy.

	Week-days	Sundays
January	1,397	2,202
February	5,510	3,531
March	7,526	4,881
April	8,494	5,919
May	8,877	15,910
June	7,141	6,824
July	6,601	10,987
August	13,608	10,811
September	14,981	13,188
October	10,039	9,619
November	40,189	53,200
December	5,470	5,339
	129,833	142,411
		129,833
Total		272,244

ANNUAL BEQUESTS

The Annual Flower Sermon, provided for in the will of Mr. Shaw, was preached at Christ Church Cathedral, on May 16, by Rev. S. N. Watson, Rector Emeritus of the Church of the Holy Trinity, Paris, France.

The Gardeners' Banquet was held in the floral display house at the Garden on the night of September 15.

The banquet of the Board of Trustees of the Garden was held at the Missouri Athletic Association on the evening of January 2, on the occasion of the seventy-second meeting of the American Association for the Advancement of Science in session in St. Louis at that time.

The $500 bequest, provided by Mr. Shaw "for premiums or prizes at a flower show or exhibit" was awarded in connection with the spring flower show of the Garden Club of St. Louis.

RESEARCH AND INSTRUCTION

It has previously been noted that the number of courses offered primarily for graduate students during 1919-20 was a minimum, due to the fact that relatively few new students were admitted. This also holds true for the work proposed during 1920-21. During the latter year there are being given or are proposed for the second semester the following courses: taxonomy of the bryophytes and pteridophytes, history of botany, advanced physiology, seminar, and in addition research work in applied mycology, physiology, and taxonomy.

Scientific and Popular Lectures.—Among the scientific and popular lectures given by members of the scientific and Garden staffs the more important are the following:

W. H. Chambers, April 14, before the Division of Biological Chemistry of the American Chemical Society, "The Relation of Dextrose to H-ion Concentration with Bacillus Coli."

B. M. Duggar, April 14, before the Division of Biological Chemistry of the American Chemical Society, "The Effect of Conditions on the Relation of Seed Plants to H-ion Concentration of Nutrient Solutions."

B. M. Duggar, October 15, before Town and Gown, "The Japanese Problem in California."

B. M. Duggar, November 3, before the St. Louis Association of Gardeners, "Mushrooms, Native and Cultivated."

B. M. Duggar, November 30, before the Graduate Club, Washington University, "The Work of the National Research Council and Its Influence on Research in the University."

B. M. Duggar, December 15, before the St. Louis Natural History Museum Association, "Native Mushrooms and Their Habitats."

B. M. Duggar, December 16, before the Garden Club of St. Louis, "The History of a Mushroom Bed and Mushroom Production."

Adele Lewis Grant, March 23, before the Asclepios, the Biological Society of Washington University, "The Economic Value of Some of Our Summer Birds."

L. P. Jensen, January 20, before the Garden Club of St. Louis, "The Use of Native Plants in Gardens."

L. P. Jensen, January 16, before the Chapter House, Edwardsville, Illinois, "Landscape Gardening."

D. Miller and Adam Huber, March 3, before the St. Louis Association of Gardeners, "Orchids."

G. T. Moore, October 19, before the Patrons-Teachers' Association of Sherman School, "The Missouri Botanical Garden as a Neighborhood Institution."

G. T. Moore, December 17, before Town and Gown, "Some Old Herbals and the Doctrine of Signatures."

G. H. Pring, February 18, before the St. Louis Natural History Museum Association, "Curiosities of Plant Life."

G. H. Pring, April 20, before the Webster Groves High School, "Spring Planting."

H. von Schrenk, September 1, before the Association of Engineering Societies at San Francisco, "Wood Preservation."

HENRY SHAW, 1887.

HENRY SHAW, ABOUT 1888.

H. von Schrenk, September 15, at the Annual Gardeners' Banquet, Missouri Botanical Garden, "Pacific Coast Trees."

H. von Schrenk, September 22, before the Roadmasters and Maintenance of Way Association Convention, St. Louis, "Where Are Our Ties Coming From?"

H. von Schrenk, October 12, before the Garden Club of St. Louis, "Pacific Coast Trees."

H. von Schrenk, October 14, before the American Society for Municipal Improvements, "Recent Developments in Wood Block Paving."

H. von Schrenk, October 18, before the Academy of Science of St. Louis, "The Forest Resources of the United States."

H. von Schrenk, November 12, before the American section of the Society of Chemical Industry, at the Chemists' Club, New York, "The Preservative Treatment of Wood, Its Broader Aspects and Some of Its Technical Phases."

Graduates, Fellows, and Investigators.—Unusual conditions prevailed at the beginning of the academic year 1920-21, owing to the exceptional number of calls for scientifically trained young men and women. Several fellowships were vacated for the reasons mentioned, and it was impossible to fill these vacancies with men of adequate promise. There were registered for graduate work during the calendar year the following students: G. M. Armstrong, Rufus J. Lackland research fellow; W. H. Chambers, Rufus J. Lackland research fellow; Adele Lewis Grant, teaching fellow, Washington University; Takashi Matsumoto, formerly laboratory assistant; E. B. Payson, teaching fellow, Washington University; R. W. Webb, formerly research assistant; F. S. Wolpert, Rufus J. Lackland research fellow. In addition Doctor Norma E. Pfeiffer, assistant professor of botany, University of North Dakota, and Mr. F. P. McWhorter, fellow, department of botany, University of Chicago, have been in residence, using the facilities of the laboratory, library, and herbarium.

For 1920-21 appointments were made to the Rufus J. Lackland research fellowships as follows: G. M. Armstrong, B. S. Clemson College, M. A. University of Wisconsin, formerly extension pathologist, Bureau of Plant Industry, reappointed second year; R. W. Webb, B. S. Clemson College, A. M. Washington University, formerly research assistant; F. S. Wolpert, A. B. University of Montana, formerly assistant in botany, University of Montana, reappointed second year.

Other appointments for the same period were as follows: Joanne L. Karrer, B. S. University of Washington, M. S. University of Washington, Ph. D. Washington University,

formerly teaching fellow, appointed research assistant; Adele Lewis Grant, B. S. University of California, A. M. Washington University, formerly teaching fellow, appointed to a Jessie R. Barr fellowship in Washington University (resigned); E. B. Payson, B. A. University of Wyoming, A. M. Washington University, formerly teaching fellow, reappointed teaching fellow.

Graduate students terminating their connection with the Garden after receiving degrees were as follows: W. H. Chambers, to accept the position of research associate in the Barnard Skin and Cancer Hospital, St. Louis; Takashi Matsumoto, to return to his appointment, professor of botany, Imperial College of Agriculture and Forestry, Morioka, Japan; Mrs. Adele Lewis Grant, to accept an instructorship in botany in the New York State College of Agriculture, Cornell University.

At the Commencement of Washington University, June 10, 1920, the degree of Doctor of Philosophy was conferred upon W. H. Chambers, with a thesis on "Studies in the Physiology of the Fungi. XI. Bacterial Inhibition by Metabolic Products"; Takashi Matsumoto, with a thesis on "Physiological Specialization in Rhizoctonia Solani Kuhn"; and Joanne L. Karrer, with a thesis on "Amylase Production and Activity in Fungi as Affected by Hydrogen Ion Concentration." The degree of Master of Arts was conferred upon E. B. Payson, with a thesis on "A Monograph of the Genus Lesquerella."

Publications and Papers.—The various scientific articles which have been published during the year whether in the Annals or in other journals are included by title in the list below. Several graduate theses as well as staff investigations remain unpublished, and much of this material will be used in the next few numbers of the ANNALS.

In the graduate laboratory particular attention has been paid to various aspects of the relation between hydrogen-ion concentration and certain life phenomena. The mineral and organic food nutrition of higher plants continues to receive considerable attention. Consistent efforts are also being made to throw light upon the causal relations in mosaic diseases.

Allen, E. R. "On Carbohydrate Consumption by Azotobacter chroococcum." Ann. Mo. Bot. Gard., 1920.

Burt, E. A. "The Thelephoraceae of North America. XII." Ann. Mo. Bot. Gard., 1920.

Chambers, W. H. "Studies in the Physiology of the Fungi. XI. Bacterial Inhibition by Metabolic Products." Ann. Mo. Bot. Gard., 1920.

HENRY SHAW.
DRAWN BY VON SALTZA IN 1893. A COMPOSITE OF VARIOUS PORTRAITS.

HENRY SHAW.
PAINTED BY RICHARD MILLER AFTER THE DEATH OF MR. SHAW.
COMPILED FROM THE VARIOUS PORTRAITS.

Duggar, B. M. "Botany." Am. Year Book, 1920.

Duggar, B. M. "Hydrogen Ion Concentration and the Composition of Nutrient Solutions in Relation to the Growth of Seed Plants." Ann. Mo. Bot. Gard., 1920.

Duggar, B. M. "The Nutritive Value of the Food Reserve in Cotyledons." Ann. Mo. Bot. Gard., 1920.

Duggar, B. M. "The Nutritive Value of the Food Reserve in Cotyledons." Carnegie Inst., Washington, Year Book, 1920.

Duggar, B. M. "Refinements in the Indicator Method of Hydrogen Ion Determination." Carnegie Inst., Washington, Year Book, 1920.

Duggar, B. M. "Some Factors in the Salt Requirements of Plants." Carnegie Inst., Washington, Year Book, 1920.

Duggar, B. M. "The Use of 'Insoluble' Salts in Balanced Solutions for Seed Plants." Ann. Mo. Bot. Gard., 1920.

Jensen, L. P. "Influence of Parks on Civilization and Conservation of Plant Life." Parks and Recreation, 1920.

Jensen, L. P. "Public Parks as Bird Protectorates." Parks and Recreation, 1920.

Karrer, J. L. and R. W. Webb. "Titration Curves of Certain Liquid Culture Media." Ann. Mo. Bot. Gard., 1920.

Zeller, S. M. "Humidity in Relation to Moisture Imbibition by Wood and to Spore Germination on Wood." Ann. Mo. Bot. Gard., 1920.

During the convocation week of the American Association for the Advancement of Science and affiliated societies held in Chicago, December 27-January 1, the following papers were presented by members of the staff and graduate students:

Armstrong, G. M. "Sulphur Nutrition of the Fungi, with Special Reference to the Use of Thiosulphate in Relation to Hydrogen-Ion Concentration."

Duggar, B. M. "The Use of 'Insoluble' Salts in Balanced Solutions for Seed Plants."

Karrer, J. L. "The Effect of Hydrogen-Ion Concentration Upon the Accumulation and Activation of Amylase Produced by Certain Parasitic Fungi."

Brief indications are given below of the nature and significance of the scientific papers published in the ANNALS during the calendar year.

Allen, E. R. (Ann. Mo. Bot. Gard. 7:75-79), in a study of *Azotobacter chroococcum*, shows that contrary to expectation a declining metabolic activity is exhibited by this organism in reference to carbohydrate consumption. Carbohydrate consumption is not related to the rate of increase in cell num-

bers, but is the reverse of this process. Mechanical agitation also influences carbon assimilation.

Burt, E. A. (Ann. Mo. Bot. Gard. 7:81-248), continuing a monograph of the Thelephoraceae of North America, presents a comprehensive account of the genus Stereum. This is a large genus, but the author finds the difficulties of identification, experienced by so many, greatly lessened after a thorough study and analysis of the microscopically recognizable organs or combinations of organs. The work includes an elaborate key to the species; and under each of the 77 American species discussed there are given the synonymy and references to literature, full diagnosis, notes on occurrence, habits, and peculiarities, citations of specimens examined, etc. Among the 77 species referred to, twelve are new, and five new combinations are included. In addition notes are recorded on 10 imperfectly known species and 20 species are excluded from the genus. A continuation is promised. The new species are *S. caespitosum, S. saxitas, S. pubescens, S. conicum, S. patelliforme, S. Earlei, S. magnisporum, S. spumeum, S. erumpens, S. sepium, S. heterosporum,* and *S. durum.*

Chambers, W. H. (Ann. Mo. Bot. Gard. 7:249-289) has studied the intestinal organism *Bacillus coli* in respect to the inhibition of growth by the products of its metabolism in culture on media containing and lacking carbohydrates. No "autotoxin" was found, but growth and death of the Bacillus in dextrose bouillon is dependent on the hydrogen-ion concentration of the medium, and if the latter is controlled the maximum count of cells may be more than ten times as great as in cultures where the acidity is uncontrolled. He demonstrates that there is no constant curve of growth and that any such curve is dependent upon the reaction of the medium.

Duggar, B. M. (Ann. Mo. Bot. Gard. 7:1-49) has introduced a new culture solution for the higher plants consisting of the four salts, potassium nitrate, magnesium sulphate, calcium sulphate, and soluble ferric phosphate. In the majority of cases this combination has afforded a growth of wheat and corn exceeding all other culture media. External conditions, however, influence notably the value of any particular culture medium, and the writer is convinced that there is no single "best" culture solution for the plants thus far studied. Under ordinary conditions H-ion concentration may be a limiting factor in the growth of plants in solutions containing the acid phosphates.

Duggar, B. M. (Ann. Mo. Bot. Gard. 7:291-298). It is shown that peas deprived of their cotyledons during the first

week of growth are materially dwarfed in further development. No organic nitrogenous nutrients or combinations of nutrients have thus far been found which will fully compensate for the food reserve naturally provided by the cotyledon. It is suggested that possibly a specific vitamine is involved in the effectiveness of the cotyledon.

Duggar, B. M. (Ann. Mo. Bot. Gard. 7:306-328) has experimented with the use of relatively insoluble salts in balanced nutrient solutions for certain seed plants—including corn and wheat in the data reported. It is pointed out that combinations of such salts are interesting (1) because of the constant concentration of most of the ions representing the necessary elements, and (2) because no renewal of solutions is required from time to time. It was found necessary to employ a soluble nitrate. Highly favorable yields are reported for several combinations involving two or more relatively insoluble salts, and further work is projected.

Karrer, Joanne L. and R. W. Webb. (Ann. Mo. Bot. Gard. 7:299-305). For the benefit of subsequent workers complete titration curves of certain liquid culture media for the fungi have been worked out. These curves cover the entire range of acidity and alkalinity within which the common mould fungi ordinarily grow.

Zeller, S. M. (Ann. Mo. Bot. Gard. 7:51-73). This paper reports in extensive tables and curves the moisture content for sap- and heart-wood of both longleaf and shortleaf pine at various humidities and at 25° C. Attention is again drawn to the fact that although highly resinous samples exhibit a strong water-proofing effect, still the unequal distribution of resin is a factor in the weakness of wood in respect to decay by fungi. The fungus *Lenzites saepiaria* will germinate on wood shavings at relative humidities about 63 per cent, and is accelerated when the humidity is high enough to maintain fiber saturation.

HERBARIUM

The herbarium has had a normal growth during the year by the addition of new material from various parts of the world. Particular attention, however, has been given to augmenting the collections representing the flora of the central and western parts of the United States. The new steel cases which were installed late in 1919 have relieved temporarily the congestion in that part of the herbarium which includes the monocotyledonous plants. Thus, it has been possible to more thoroughly organize several of the families in this series which

enhances the usefulness and value of the herbarium for study and comparison.

New Accessions.—The total number of herbarium specimens received during the past year is considerably smaller than in any one year for the last decade, owing to the fact that purchases have been confined mainly to current series of *exsiccati*. One small private herbarium has been secured, namely, that of the late E. W. Hammond whose collections were made chiefly in southern Oregon and extended over a period of several years. Other noteworthy accessions acquired since the last annual report are the following: from the Arnold Arboretum, 1168 plants collected by E. J. Palmer, principally in the Ohio and Mississippi River Valleys; C. F. Baker, 100 "Fungi Malayana"; E. Bartholomew, 200 "North American Uredinales"; Sydney Botanic Gardens, 100 plants of Australia; T. S. Brandegee, 212 plants of Mexico; Willard N. Clute, 108 plants of the Painted Desert, Arizona; Bureau of Plant Industry, Washington, D. C., 53 duplicate fungi from the Langlois Herbarium; Bureau of Science, Manila, 153 fungi of the Philippine Islands; Ira W. Clokey, 270 plants of Colorado; Rev. John Davis, 213 plants mainly from Michigan, South Carolina, and Nebraska; J. A. Drushel, 81 plants of Ohio, Illinois, Missouri, and Texas; D. Lewis Dutton, 888 plants of Vermont and Florida; Field Museum of Natural History, 40 fungi from Santa Catalina Island; Miss Marie Gocker, 63 plants of Cameroun, West Africa; Mrs. Adele Lewis Grant, 44 plants of California; W. S. Hammond, the private herbarium of the late E. W. Hammond, estimated at 700 specimens; A. A. Heller, 400 plants of Oregon and California; A. S. Kalenborn, 141 plants of Peru; C. Mereschkovsky, 100 "Lichenes ticinenses exsiccati"; New York Botanical Garden, 225 algae, chiefly from the West Indies, and 58 Scrophulariaceae from Colombia and eastern United States; E. B. Payson, 679 plants of Montana, Wyoming, Colorado, and Idaho; Morton E. Peck, 483 plants of Oregon; Pomona College, 35 specimens of Mimulus and Senecio from California; Frank C. Seymour, 94 plants of Massachusetts; W. N. Suksdorf, 152 plants of Montana and Washington; U. S. National Museum, 300 "American Grasses"; U. S. Entomological Laboratory, Kingsville, Texas, 60 plants of Texas; Th. Oswald Weigel, 122 plants of the Philippine Islands, and 124 fungi from Europe and South America. Numerous smaller collections have been received, a detailed list of which has been recorded in current numbers of the BULLETIN.

Mounting and Distribution.—The mounting of herbarium material has continued throughout the year; and nearly 15,000 mounted specimens have been added to the organized herbarium. Much time has been devoted to the sorting and distribution of specimens in order to render the collections more readily available and of greater service to the investigator.

Field Work.—Systematic field work in the Southwest was again discontinued this year, but through coöperation with the Arnold Arboretum a complete series of the valuable collections made by Mr. Ernest J. Palmer in the Ohio and Mississippi River Valleys has been secured. Through a coöperative arrangement between the University of Wyoming and the Garden herbarium Mr. and Mrs. E. B. Payson spent about two months in the field mainly in northwestern Wyoming and adjacent Idaho from which an excellent series of herbarium specimens was obtained. These plants are of especial interest since they come from a comparatively little explored region and since they greatly augment rather fragmentary collections made by Henry Engelmann on one of the early government surveys. Local field work has been carried on to a limited extent; and numerous friends of the Garden have deposited in the herbarium local collections of special interest.

Exchanges.—A number of important series of herbarium specimens have been acquired from institutions with which the Garden maintains exchange relations. A comparatively small number of duplicates, however, has been sent out during the year.

Use of the Herbarium by Outside Botanists.—The number of visiting botanists who have consulted the herbarium during the year is again relatively large; and every facility possible has been extended to the visiting specialist. It has been necessary to further limit the loan of herbarium material, because of frequent fragmentation of specimens and the undue amount of salaried time required to draw out and carefully record the specimens loaned as well as the redistribution of them upon their return. A few small loans have been made to a very decided mutual advantage. Dr. Norma E. Pfeiffer, of the University of North Dakota, spent some time at the herbarium during the past summer in pursuance of her monographic study of Isoetes. This work will probably be ready for publication some time during the coming year.

Statistical Summary: (For the year ending December 31, 1920):

Number of specimens received on new accessions:			
By purchase	5,141		
By gift	808		
By exchange	1,154		
By field work	679		
Total	7,782	valued at	$778.20
Number of specimens mounted and incorporated	14,155	valued at	2,831.00
Number of specimens discarded from the herbarium	37		
Number of specimens in organized herbarium	861,824	valued at	132,336.65
Number of specimens in unorganized herbarium (estimated)	72,167	valued at	5,773.36
Wood specimens, etc., supplementing the herbarium		valued at	280.00
Microscope slides, etc.		valued at	410.00
Total valuation			$142,209.21

LIBRARY

The duties of the library force during the year have consisted for the most part: first, in incorporating into the library both the many hundreds of serial botanical publications regularly received and the extensive accessions of new books and pamphlets acquired by donation and purchase; and second, in editing and distributing to exchanges and subscribers the publications of the Garden.

In addition to the above the limited space available for the library has necessitated extensive shifting of books, as current additions to the various sections have required more space than remained available. Greatly needed room for such expansion was obtained during the year by moving the books of sections G, plant physiology, and H, biography, to the room formerly used by the Red Cross workers as a cutting room. These new quarters contain tables and a good reading light, thus providing means for preliminary consultation by students of the books in these sections.

Publications.—The current volume, vol. VII, of the ANNALS OF THE MISSOURI BOTANICAL GARDEN, which is our principal exchange for publications of scientific societies and institutions, contains 335 pages, 7 plates, and 82 text figures, and records the results of scientific researches by the scientific staff and graduate students of the Garden. It has been computed that the value of exchanges received for the ANNALS

is about $1500 at pre-war prices. Some exchanges are received for the Garden BULLETIN. Both the ANNALS and the BULLETIN are supplied to regular subscribers; separates of the various articles in the ANNALS are for sale by the library. The cash receipts for subscriptions and separates for the year were $339.51.

Loans of Books.—During the year there were loans of 90 books to 20 institutions for use by their botanists. Such loans are made on the interlibrary plan; the borrower makes application for the loan through the library of his university, which is responsible for the return of the book in good condition at expiration of the loan and for payment of transportation both ways. Many botanists visited the library at intervals during the year and consulted literature in their special fields.

Statistical.—There have been donated to the library 516 volumes, valued at $987.07, and 1,652 pamphlets, valued at $236.83; and there was purchased 392 volumes valued at $1,514.14, and 49 pamphlets valued at $44.20. The library now contains 37,554 books and 49,484 pamphlets, a total of 87,038, valued at $128,099.42. There are also 329 manuscripts, valued at $1,605.80, and 946,476 index cards, valued at $9,680.47. A total of 9,331 index cards have been added during the year, of which 976 were typewritten by library employees, and 8,335 purchased at a cost of $132.20. Five hundred and forty-seven books were bound.

Respectfully submitted,

GEORGE T. MOORE,
Director.

STATISTICAL INFORMATION FOR DECEMBER, 1920

GARDEN ATTENDANCE:
Total number of visitors.....10,809

PLANT ACCESSIONS:
Total number of packets of seed received in exchange... 2

LIBRARY ACCESSIONS:
Total number of books and pamphlets bought..... 25
Total number of books and pamphlets donated..... 148

HERBARIUM ACCESSIONS:

By Purchase—
Arnold Arboretum—Plants of the Ohio River Valley, Missouri, etc., collected by E. J. Palmer in 1920.....1,168
T. S. Brandegee—Plants of Mexico, collected by C. A. Purpus in 1920..... 112

By Gift—
Dr. R. P. Burke—Fungi of Alabama..... 20
Prof. W. C. Coker—Fungi of North Carolina..... 14
Dr. Charles E. Fairman—*Merulius incarnatus* Schw..... 1
Prof. H. S. Fawcett—*Hymenochaete spreta*..... 1
Field Museum of Natural History—Fungi of Santa Catalina Island 40
Miss Ann Hibbard—*Clavularia subcaespitosa* Peck from type locality, and other fungi..... 7
F. P. McWhorter—Fungi about St. Louis..... 3
Dr. L. O. Overholts—*Aleurodiscus cerussatus* from Manitoba 1
W. N. Suksdorf—Plants of Washington..... 40
Hon. Geo. Whitfield Jack—Cultivated specimen of *Ilex cornuta* Lindl. from Louisiana..... 1

By Field Work—
Plants of Montana, Wyoming, Colorado and Idaho, collected by E. B. Payson in 1920..... 670

Total.....2,078

The Garden is open to the public every day in the year, except New Year's, Fourth of July, Labor Day, and Christmas—week days from 8:00 A. M. until one-half hour after sunset; Sundays from December to April, 1:00 P. M. until sunset, from April to December, 2:00 P. M. until sunset.

The main entrance to the Garden is located at Tower Grove Avenue and Flora Boulevard, on the Vandeventer Avenue car line. Transfer south from all intersecting lines.

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OF THE MISSOURI BOTANICAL GARDEN

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MISSOURI BOTANICAL GARDEN BULLETIN

Vol. IX FEBRUARY, 1921 No. 2

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GOLD MEDAL AWARDED BY NATIONAL ASSOCIATION OF GARDENERS TO MR. G. H. PRING, HORTICULTURIST TO THE GARDEN, FOR CREATION OF NEW WATER-LILY.

Missouri Botanical Garden Bulletin

Vol. IX St. Louis, Mo., February, 1921 No. 2

TRAPA BICORNIS (BULL'S HEAD)

Recently visitors have brought to the Garden for identification seeds, purchased in St. Louis and represented to be those of a large-flowered water-lily equal in size to the Easter lily and having either white or pink flowers. This has been identified as *Trapa bicornis*, or bull's head, a species most interesting from the standpoint of mimicry, the seeds closely resembling a bull's head in shape.

This plant is indigenous to the shallow rivers and undrained marshes of China, where it is cultivated very extensively as a substitute for corn. In the young state the plant is submerged, the seeds germinating in the muddy bottom of a stream or lake. The primary shoot or radicle appears between the horns, and from this the roots extend, penetrating the soil and attaching the young plant to the mud. The foliage consists of two distinct types: first, the submerged leaves, which are linear and somewhat resemble roots in shape; second, the floating or air leaves which appear when the plant reaches the surface of the water. The latter are rounded, about three-quarters of an inch across, the upper surface of a light green color, the under side purple and hairy. The petioles, which support the leaves, contain spongy pith which makes them buoyant. The flowers are small, solitary, of a pellucid white color, comprised of four petals about an inch in width. The peduncles which support them bend when the flower drops, thus allowing the seed to ripen under water. The basal portion of the seed, which represents the mouth of the bull, is the connection between seed and plant. Therefore, in ripening the horns are reversed. The natives of China call the seeds "ling."

In 1781 Solander introduced the southern European species, *Trapa natans* (water caltrops), into northern France and attempted to bring it to fruit in the open air, but failed. At a later date, Lambert, of Boyton, England, succeeded in ripening seeds under greenhouse treatment. The genus was named by Linnaeus from calcitrapa, or caltrops, an instru-

ment of ancient warfare, on account of the resemblance of the seed to that instrument. Other common names are water chestnut and Jesuit's nut. In some parts of Europe the seeds are ground into flour and used in bread making. Roasted or boiled, they are used also as a dessert in much the same manner as the Spanish chestnut. Another species of economic value is *Trapa bispinosa,* a native of India, where, especially in Kashmir, the seeds are said to furnish an article of food for 30,000 people for five months of the year.

HARDY EXOTIC PLANTS SUITABLE FOR THE GARDENS OF MISSOURI AND ADJOINING STATES

During the year 1920, there was published in the BULLETIN a list of native plants suitable for the gardens of Missouri and adjoining states. This list was arranged according to the habitat of the plant, and in addition to certain information as to the color of flower, approximate size, etc., some indication was given as to the way in which the plants could be most satisfactorily used. The practical value, to both the amateur and commercial grower, of this arrangement of the wild plants of our region, has been so great that there have been numerous requests for a similar treatment of the cultivated plants. There will accordingly be listed in the succeeding numbers of the BULLETIN during 1921 the exotic plants suitable for the gardens of Missouri and adjoining states, classified in practically the same manner as were the wild plants. It is hoped that by furnishing this information those interested may be able to make a more intelligent selection of both wild and cultivated plants for use in gardens in and about St. Louis.

I. HARDY EXOTIC PLANTS FOR ROCK GARDENS

Botanical name	Common name	Approx. height	Color of flowers	Approx. time of bloom	Habitat
PLANTS GROWING IN DRY, SUNNY SITUATIONS					
Alyssum argenteum	Silvery golden-tuft	8-12"	Yellow	Summer	Europe
Alyssum saxatile	Golden-tuft	1'	Yellow	Early spring	Europe
Aquilegia sibirica	Siberian columbine	1-2'	Lilac blue	Summer	Siberia
Arabis albida	Rock-cress	4-6"	White	Early spring	Europe
Arabis alpina	Rock-cress	6-8"	White	Early spring	Europe
Arenaria grandiflora	Sandwort	4-6"	White	April-June	Europe
Arenaria verna	Sandwort	1-3"	White	April-June	Europe

TRAPA BICORNIS.
Seed and Young Plant.

Botanical name	Common name	Approx. height	Color of flowers	Approx. time of bloom	Habitat
Armeria latifolia	Sea-pink	12-15"	Pink	Summer	S. Europe
Armeria maritima	Sea-pink	12-15"	Pinkish white	Summer	Europe
Belamcanda chinensis	Blackberry lily	2-3'	Orange, spotted red	May-June	China to Japan
Cerastium Biebersteinii	Chickweed	6" (creeping)	White	May-June	Tauria
Cerastium grandiflorum	Chickweed	6-8" (creeping)	White	May-June	E. Europe
Cerastium tomentosum	Chickweed	4-6" (creeping)	White	May-June	Europe
Cheiranthus Cheiri	Wallflower	1-1½'	Yellow	April-May	S. Europe
Chionodoxa Luciliae	Glory-of-the-snow	3-6"	Blue	Feb.-March	Asia Minor
Coronilla cappadocica	Yellow crown-vetch	1'	Yellow	July-Aug.	Asia Minor
Coronilla varia	Crown-vetch	1-2' (trailing)	Pinkish white	June-Oct.	Europe
Dianthus cinnabarinus	Pink	1'	Red	Aug.-Sept.	Greece
Dianthus deltoides	Maiden pink	6-10" (tufted)	Red	Spring-summer	Europe, Japan
Erigeron aurantiacus	Flea-bane	9"	Orange	July-Aug.	Turkestan
Erysimum ochroleucum	Erysimum	4-12"	Pale yellow	May-June	Spain
Erysimum rupestre	Erysimum	12-18"	Orange	May-June	Asia Minor
Galanthus Elwesii	Giant snowdrop	4-8"	White	Early spring	Asia Minor
Galanthus nivalis	Common snowdrop	6-8"	White	Feb.-March	Caucasus
Geranium argenteum	Silver-leaved cranesbill	3"	Pink	June-Aug.	Carnic Alps
Geum coccineum	Red geum	1'	Bright red	Summer	Greece
Geum reptans	Plumy geum	2-4" (procumbent)	Yellow	Summer	Europe
Gypsophila repens	Trailing baby's breath	2-4"	White or rose	Summer	Europe
Hieracium aurantiacum	Orange hawkweed	6"-2'	Orange	Aug.-Sept.	Europe
Iberis sempervirens	Evergreen candy-tuft	4-8"	White	Early spring	Europe

Botanical name	Common name	Approx. height	Color of flowers	Approx. time of bloom	Habitat
Iberis sempervirens var. *rosea*	Evergreen candy-tuft	4-8"	Red	Early spring	Europe
Meconopsis cambrica	Welsh poppy.	6-12"	Yellow	Summer	W. Europe
Paronychia argentea	Whitlow-wort.	2-4" (prostrate)	White	May-June	Europe
Potentilla argyrophylla	Five-finger	2-3'	Yellow	June-July	Himalayas
Potentilla nepalensis	Potentilla	1-1½'	Yellow	May-June	Himalayas
Potentilla verna	Early potentilla	4-10" (procumbent)	Yellow	April-May	Europe
Sedum acre	Stonecrop	2-3"	Yellow	June-July	Europe
Sedum Aizoon	Stonecrop	1-2'	Yellow	Late summer.	Siberia
Sedum album	White stonecrop	4-6"	White	July	Europe
Sedum lydium	Stonecrop	3-6"	Pinkish	Aug.-Sept.	Asia Minor
Sedum oppositifolium	Stonecrop	6" (trailing)	White or pinkish	July-Aug.	Asia, Persia
Sedum roseum	Stonecrop	6-8" (trailing)	Reddish purple	Summer	Europe
Sedum Sieboldii	Siebold's stonecrop	9"	Pinkish	August	Japan
Sedum stoloniferum	Stonecrop	6" (trailing)	Pink	July-Aug.	Asia, Persia
Veronica gentianoides	Gentian-leaved speedwell	6-18"	Pale blue	Summer	Europe
Veronica incana	Hoary speedwell	12-18"	Blue	July-Sept.	Asia, Europe
Veronica pectinata	Scalloped-leaved speedwell	6" (prostrate)	Blue	May-June	Asia Minor
Veronica repens	Creeping speedwell	2-4" (prostrate)	Blue	May	Europe
Veronica rupestris	Speedwell	4-5"	Purplish	June	Europe
Vinca minor	Periwinkle	4-6" (prostrate)	Blue	May-June	Europe

PLANTS GROWING IN MOIST, SUNNY SITUATIONS

Geranium sanguineum	Cranesbill	1'	Red	May-Aug.	Europe
Linum austriacum	Flax	1-2'	Violet-red or light blue	Summer	Austria

Botanical name	Common name	Approx. height	Color of flowers	Approx. time of bloom	Habitat
Lotus corniculatus	Bird's-foot trefoil (trailing)	6-12"	Yellow	Summer	Australia
Lychnis Haageana	Lychnis	8-12"	Red	Summer	Europe
Primula veris	Cowslip	4-6"	Orange-yellow	May-June	Europe
Ranunculus repens var. *flore pleno*	Creeping double buttercup (creeping)	6-10"	Yellow	May-July	Europe, Asia
PLANTS FOR MOIST, SOMEWHAT SHADED SITUATIONS					
Asperula odorata	Sweet woodruff	6-8"	White	May-July	Europe, Orient
Asperula tinctoria	Dyer's woodruff (prostrate)	1-2'	Reddish	May-July	Europe
Brunella grandiflora	Self-heal	12-15"	Purple	Summer	Europe
Galium Mollugo	Bedstraw	1'	White	May-June	Europe
Polygonatum multiflorum	Solomon's seal	2-3'	White	May-June	Europe, Asia
Pulmonaria officinalis	Lungwort	6-12"	Reddish violet	April	Europe

II. HARDY EXOTIC PLANTS FOR THE WATER GARDEN

Botanical name	Common name	Color of flowers	Approx. time of bloom	Habitat
HERBACEOUS PLANTS GROWING IN WATER				
Myriophyllum verticillatum	Parrot's feather (in shallow water or floating)	Inconspicuous		Europe
Nelumbo nucifera	Egyptian lotus	Pink	Summer	Asia, Australia
Nelumbo nucifera var. *rosea*	Egyptian lotus	Rose	Summer	Asia, Australia
Nuphar luteum	European yellow lily	Yellow	Summer	Europe
Nuphar minimum	Small European yellow lily	Yellow	Summer	Europe
*Nymphaea alba**	White water-lily	White	Summer	Europe

*There are many hybrids of *Nymphaea alba* and *Nymphaea alba* var. *rosea* which are desirable and hardy. Their flowers are white, pink, rose, red, and yellow, and they are very prolific bloomers.

Botanical name	Common name	Color of flowers	Approx. time of bloom	Habitat
Nymphaea alba var. *rosea*	Water-lily	Rose	Summer	Sweden
Nymphaea candida	White water-lily	White	Summer	Europe
Nymphaea tetragona	Yellow water-lily	Yellow	Summer	China, Japan

Botanical name	Common name	Approx. height	Color of flowers	Approx. time of bloom	Habitat
HERBACEOUS PLANTS GROWING IN SWAMPS OR ON MUDDY SHORES					
Cardamine pratensis	Cuckoo flower	12-20"	White or rose		Europe
Sagittaria sagittifolia	Old World arrow-head	1-3′	White	July-Aug.	Europe, Asia
Senecio japonicus	Japanese groundsel	4-5′	Yellow.	May-June	Japan
Sium latifolium	Water parsnip	4-5′	White.	Summer	Europe
HERBACEOUS PLANTS FOR VERY MOIST SOIL					
Hemerocallis aurantiaca and varieties	Orange day-lily	2-3′	Orange.	July-Sept.	Japan
Hemerocallis Dumortierii	Day-lily	1-3"	Orange.	May-June	Japan
Hemerocallis flava	Lemon lily	18-24"	Yellow	May-June	Europe, Asia
Hemerocallis fulva	Day-lily	18-24"	Orange.	July-Aug.	Europe
Hemerocallis Middendorfi	Middendorf's day-lily	1-2′	Yellow	May-June	Amur
Iris aurea	Yellow iris	3-3½′	Yellow	June	Himalayas
Iris laevigata and its varieties	Japanese iris.	2½-3′	Blue, violet, white.	June	Siberia, Japan
Iris florentina	Florentine iris	1-2′	White	May	Europe
Iris Gueldenstaedtiana	Iris	1-2′	Yellow	May	Asia
Iris Pseudacorus	Iris	2-3′	Yellow	May-June	Europe
Ranunculus asiaticus	Buttercup	6"-1′	Yellow	May-June	Asia Minor
Ranunculus bulbosus	Bulbous buttercup	1′	Yellow	April-June	Persia, Europe
HERBACEOUS SHRUBS FOR WATERSIDE PLANTING					
Alnus viridis	Green alder	3-6′	Inconspicuous.	Early spring	Northern Hemisphere
Cornus sanguinea	Red-branched dogwood	8-12′	White.	May-June	Europe
Salix Caprea	Goat willow.	12-20′	Inconspicuous		Europe, Asia

Botanical name	Common name	Approx. height	Color of flowers	Approx. time of bloom	Habitat
Salix incana	Willow	15-25′	Inconspicuous		Europe
Sambucus nigra	European elder	15-25′	White	May-June	Europe
Sambucus nigra var. *aurea*			Yellow foliage		
Sambucus nigra var. *laciniata*			Cut-leaved foliage		

TREES FOR WATERSIDE PLANTING

Alnus glutinosa	Black alder	50-70′	Inconspicuous		Europe
Betula alba and varieties	European white birch	60-80′	Inconspicuous		Europe, Japan
Betula Ermanii	Erman's birch	40-60′	Inconspicuous		Asia, Japan
Betula Maximowiczii	Birch	80-90′	Inconspicuous		Japan
Carpinus Betulus	European hornbeam	60-70′	Inconspicuous		Europe, Persia
Populus alba	White poplar	100-120′	Inconspicuous		Europe, Asia
Populus laurifolia	Certinensis poplar	80-100′	Inconspicuous		Siberia
Populus nigra	Black poplar	100-120′	Inconspicuous		Europe, Siberia
Populus tremula	European aspen	50-60′	Inconspicuous		Europe
Salix babylonica and varieties	Napoleon's willow	30-40′	Inconspicuous		Caucasus
Salix elegantissima	Thurlow's weeping willow	30-40′	Inconspicuous		Japan

NOTES

The ladies attending the convention of the Cleaners and Dyers' Association visited the Garden, January 19.

Mr. G. H. Pring, Horticulturist to the Garden, lectured before the Patrons' Association of the Mason School, February 17, on "Mimicry of Plants."

On January 5, Mr. G. H. Pring spoke before the St. Louis Association of Gardeners on "The Use of Botany to the Gardener."

On February 5, Dr. B. M. Duggar, Physiologist to the Garden, spoke before the St. Louis College Club on "Some Aspects of the Japanese Problem in California."

Dr. B. M. Duggar, Physiologist to the Garden, has been appointed Chairman of the Board of Control of "Botanical Abstracts."

Mr. John Noyes, Landscape Designer to the Garden, gave a lantern-slide lecture before the Garden Club of St. Louis, February 15, on "Garden Ornament: Its Location and Arrangement."

The January number of Parks and Recreation contains two articles by Mr. L. P. Jensen, Arboriculturist to the Garden, one entitled "Interesting Native Flowering Trees for Park Planting" and the other "Proposal for the World's Greatest Garden."

Recent visitors to the Garden include Dr. J. A. Elliott, Head of the Department of Plant Pathology, Arkansas Agricultural Experiment Station, and Mr. M. R. Ensign, Teacher of Vocational Agriculture, Lamar High School, Lamar, Arkansas.

Dr. George T. Moore, Director of the Garden, addressed the upper school of the St. Louis Country Day School, January 14, on "Commercial Botany." He also spoke before the Garden Club of St. Louis, January 18, his subject being "The Fertility of the Soil."

Due to the unseasonably warm weather a few early spring plants have flowered at the Garden. Some of those which have been noticed are: dandelion (*Taraxacum officinale*), since February 1; pussy-willow (*Salix cinerea*), since February 2; snow-drop (*Galanthus nivalis*), since February 2; willow (*Salix* sp.), since February 5; Chinese honeysuckle (*Lonicera fragrantissima*), since February 10; soft maple (*Acer saccharinum*), since February 14.

STATISTICAL INFORMATION FOR JANUARY, 1921

GARDEN ATTENDANCE:

Total number of visitors.....9,136

PLANT ACCESSIONS:

Total number of plants and seeds received as gifts..... 29

LIBRARY ACCESSIONS:

Total number of books and pamphlets bought..... 45
Total number of books and pamphlets donated..... 137

HERBARIUM ACCESSIONS:

By Purchase—

Friedländer & Sohn—Sydow's "Mycotheca Germanica," Fasc. 47, 48..... 100

By Gift—

P. van der Bijl—Fungi of South Africa..... 39
Dr. R. P. Burke—Fungi of Alabama..... 28
B. F. Bush—Plants of South Carolina..... 13
J. A. Drushel—Plants of Illinois, Missouri, Kansas, Texas, and Colorado..... 14
Dr. W. H. Emig—Mosses of Rocky Mountain Park, Alberta 269
Dr. C. E. Fairman—Monstrous *Stereum purpureum*.... 1
E. D. Hallock—Agarics of South Carolina..... 4
Dr. C. H. Kauffman—*Hymenochaete arida* and *H. spreta* 2
Prof. F. T. McFarland—*Stereum rufum* and *S. fasciatum* 2
Prof. L. O. Overholts—*Stereum rugosiusculum* and *S. rugisporum* 2
E. J. Palmer—Plants of Illinois, Kentucky, and Missouri 7
Dr. J. N. Rose—Photograph of *Echinocactus xeranthemoides* Engelm..... 1
A. T. Speare—*Septobasidium pseudopedicellatum* on the purple scale 1
Dr. R. Thaxter—*Poria cremor*, *Tulasnella calospora*, and *Hydnum chrysocomum*..... 3
Mrs. George M. Tuttle—*Atriplex hymenolytra* (Torr.) Wats. from Utah..... 1
Dr. Hermann von Schrenk—*Pinus palustris* Miller and *P. heterophylla* Sudworth from Florida..... 2
Dr. J. R. Weir—Fungi of Parecy, Brazil..... 4
Dr. J. R. Weir—Clavariae of Idaho..... 12

By Exchange—

New York Botanical Garden—Plants of the West Indies 209
University of Wyoming, by Prof. Aven Nelson—*Thelypodium* sp. 1

715

The Garden is open to the public every day in the year, except New Year's, Fourth of July, Labor Day, and Christmas—week days from 8:00 A. M. until one-half hour after sunset; Sundays from December to April, 1:00 P. M. until sunset, from April to December, 2:00 P. M. until sunset.

The main entrance to the Garden is located at Tower Grove Avenue and Flora Boulevard, on the Vandeventer Avenue car line. Transfer south from all intersecting lines.

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Construction.

MISSOURI BOTANICAL GARDEN BULLETIN

Vol. IX MARCH, 1921 No. 3

HARVARD UNIVERSITY
SCHOOL OF
LANDSCAPE ARCH

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BED OF HYBRID PERPETUAL ROSES "DUKE OF TECK."

Missouri Botanical Garden Bulletin

Vol. IX St. Louis, Mo., March, 1921 No. 3

ROSES

Of all flowers roses are perhaps the most popular, and yet many people hesitate to grow them because of the impression that their culture requires a great deal of skill. Those who do grow them are often disappointed in the results, their standard for comparison being the long-stemmed varieties produced by commercial florists. Causes for failure are often due to the desire of some amateurs to grow the newer varieties, roses suitable only for greenhouse culture, or the "bargain roses" usually placed on sale in late spring or early summer. Varieties that are grown successfully in one region may be a failure in another, and it is only by selection and trial of the many varieties listed in the rose catalogues that one is able to determine which are suited to his particular locality. The lists in this bulletin will aid those living in the vicinity of St. Louis to grow varieties that may be relied upon to thrive provided that they are given ordinary care.

Location.—This is the first and most important consideration in the establishment of a rose garden. Roses are gross feeders and require an abundance of air and sunshine. For this reason they should not be planted close to trees or shrubs whose roots extend far out in search for food. It is not necessary, however, that roses receive sunshine throughout the day, and it is to their advantage if they receive some shade. A southern or eastern exposure is good, a southeastern the best.

Soil.—The ideal soil is a clay loam, but any good garden soil sufficiently fertilized will produce results. A heavy soil may be improved by the addition of sand, and a very light soil by the incorporation of clay and organic matter.

Beds.—The size and shape of the beds should depend upon their location and the purpose for which the roses are grown. If cut flowers are the object the plants should be placed in

rectangular beds, allowing either two or three rows spaced eighteen inches apart. This permits ease in cutting and cultivating the roses without treading on the beds. Before any roses are planted the beds should be trenched to a depth of at least eighteen inches and a liberal quantity of cow- or stable-manure spaded under. In order to sweeten the soil and render available much of the plant food a coat of lime should be added before replacing the top soil. If the rose beds are in a soggy or wet location drainage should be provided by placing a layer of broken stone or drain tile at a depth or two and one-half feet. The beds should be allowed to settle before setting the plants.

Kind of Stock.—Roses may be either grown on their own roots or budded on some other stock, opinions differing as to which method gives the best results. Budded stock is easily affected by severe winters, while if the stock grown on its own roots is injured, any shoot arising from the roots will still be true to type. However, if budded plants are set sufficiently deep, some roots will eventually be produced above the bud and save the plants from loss. The harmful effect of the stock suckering is not nearly so serious as one is often led to believe. True, suckers will appear occasionally, but if the point of union between stock and scion is placed at least two inches beneath the surface when planting, very few suckers will appear and such as do will be recognized readily by their vigorous growth, thorny stems, and seven or more leaflets instead of five. Some varieties do better on their own roots, while others cannot be grown unless budded on some strong-rooted stock.

Roses may be obtained in various sizes either as growing pot plants or in dormant condition. Plate 15 shows what can be expected. With a small outlay one can secure quite a quantity and variety of small plants in 2½- and 3-inch pots which in a few years will give the desired effect. On account of the shallow roots an abundant supply of moisture must always be provided, especially during dry periods. Such plants also need much protection to carry them through a severe winter. The larger plants, supplied in 4-inch pots, have a larger root system and when planted out will continue growing and give fair results the first year. For immediate effects, however, nothing equals the heavy dormant field-grown plants supplied by most nurserymen in early spring. It is advisable to order dormant roses early, for as the season advances the rose firms must pot their stock, and express charges are then high on

ROSE STOCK READY FOR SETTING OUT.
2½-inch pot plant, 4-inch pot plant and field-grown plant.

ROSE FOLIAGE SHOWING WHITE PATCHES OF MILDEW.

APHIS ON ROSE BUD.

account of the large amount of soil that must accompany the plants.

Varieties to Plant.—The leading rose growers list many varieties, but only a limited number are successful in this vicinity. The following hybrid tea and polyantha roses have done well in the Garden and can be relied upon in St. Louis:

Admiral Ward
Betty
Clotilde Soupert (polyantha)
Coquette des Alpes (hybrid noisette)
Duchess of Wellington
Florence Pemberton
General MacArthur
Gruss an Teplitz
Katherine Zeimet (polyantha)
Killarney Queen
Lady Alice Stanley
Lady Ashtown
La France
La Tosca
Mme. Abel Chatenay
Mme. Leon Pain
Miss Cynthia Forde
Mrs. Aaron Ward
Mrs. A. R. Waddell
Mrs. Franklin Dennison
My Maryland
Ophelia
Orleans (polyantha)
Radiance
Rodhatte (polyantha)
Souv. de Pres. Carnot
Wellesley

As a rule, the hybrid perpetuals thrive and withstand the winter better than any other class of roses, their only disadvantage being the short season of bloom. The best varieties in the Garden are:

Baron de Bonstetten
Baroness Rothschild
Capt. Hayward
Clio
Duke of Teck
Frau Karl Druschki
General Jacqueminot
Hugh Dickson
J. B. Clarke
Magna Charta
Margaret Dickson
Mme. Charles Wood
Mrs. John Laing
Ulrich Brunner

The following climbers do well:

Dorothy Perkins
Dr. Van Fleet
Excelsa
Lady Gay
Silver Moon
Tausendschön

When and How to Plant.—Dormant plants may be set out if the ground is free from frost, otherwise they should be stored in some sheltered position, but not in a warm room or basement where the buds will start prematurely. Hybrid tea roses should be placed eighteen inches apart and hybrid perpetuals two to three feet. For mass effect they may be planted closer.

Budded stock should be planted so that the crown, the part from which the shoots arise, is two to three inches below the surface, and pot plants should have the ball of earth from one to two inches below the level of the bed. The holes for receiving the plants should be large enough to avoid bending

or crowding the roots, and the soil should be firmed and watered thoroughly after planting.

Dormant stock should, at the time of planting, be pruned to three or four buds to each shoot. Pot plants in leaf require very little pinching.

Fertilizers.—Without doubt, cow manure is the best fertilizer for roses, it being applied either in liquid form or as a summer mulch. If the liquid is used, about a third of a bushel of manure should be mixed with a barrel of water and applications given once or twice a week. Well-rotted horse manure is also a good fertilizer. When these are not available bone meal or sheep manure may be used, but should not be applied in as large quantities.

Spring and Summer Care.—After danger of heavy frost is past the coarse mulch should be removed and the finer portion worked into the soil with the first cultivation. As the flowering season approaches, liquid manure, diluted to the color of weak tea, should be applied once a week, about one-half gallon to each plant. During the growing season the surface soil should be frequently stirred. Roses require an abundance of water and during dry periods the beds should be given a thorough soaking once or twice a week, a light sprinkling every evening doing more harm than good. To conserve moisture and protect the roots during the extreme heat of July and August, a two- or three-inch mulch of some coarse material (strawy manure, grass clippings, or sphagnum moss) should be applied to the beds.

Diseases and Insects.—Mildew (pl. 16, fig. 1) is the commonest fungous disease in this locality. It is recognized by the gray or white patches on the leaves and young shoots and the crinkled appearance of the foliage. It may appear at any time during the growing season, cool and moist atmospheric conditions favoring it. A mixture of nine parts of sulphur and one part arsenate of lead dusted on the plants when covered with dew will usually check this disease. Bordeaux mixture is also frequently recommended, but it is unsightly.

The aphis or green fly (pl. 16, fig. 2) is the most serious insect enemy of the rose. It is a small sucking insect about ⅛ inch in length when full grown, frequently gathering in large numbers on tender shoots and about the base of flower buds. Some nicotine preparation, which can be purchased at the seed stores under various trade names, will kill these insects. Tobacco water made by steeping tobacco stems in hot water until it has the color of strong tea, may also be used. These solutions may be applied either with a whisk

broom or hand sprayer. During some seasons leaf-rollers and caterpillars are troublesome, but they may be controlled by spraying with arsenate of lead (one pound to 25 gallons of water) or by hand-picking where the number of plants is small.

Winter Protection.—The hybrid perpetuals are sufficiently hardy to withstand the winter without protection, although some covering will do them no harm. The simplest method to protect hybrid tea roses is to pile the soil around the base of each plant and then fill in between the bushes with coarse manure. This should be done about the latter part of November.

Pruning.—Before growth begins, usually in March in this locality, is the best time to prune roses. If one desires mass effect in a rose garden, the plants should be pruned only moderately. However, if good flowers for cutting are the object, the plants should be pruned severely, leaving from 3 to 6 inches of growth on the weak-growing plants, and 8 to 10 inches on the stronger ones. For exhibition flowers roses should be pruned to two buds. Whenever possible, the cut should be made about one-half inch above an outside bud, so that the leading shoot will grow outward from the bush, leaving the center open. All weak and dead wood should be removed. Hybrid perpetuals do not require severe pruning if a large number of flowers are desired (pl. 14). Polyantha and climbing roses require very little pruning.

THE ROSE GARDEN IN THE MISSOURI BOTANICAL GARDEN IN 1920

The first half of the 1920 season was unfavorable for the proper development of roses. During the mild weather the latter part of March the plants produced a quick and vigorous growth, only to be destroyed by a snow and a sudden drop in temperature the night of April 4. Recovering from this shock, the roses grew well and bloomed abundantly the latter part of May and the first of June. However, the second week of June was extremely hot followed by a week of very cool weather, and except for a shower on June 22, no rain fell until August 7. By the middle of August the bushes were again clothed with fresh foliage and the hybrid tea roses continued blooming until checked by frost on October 28. The only necessary spraying was for the aphis. Some leaf-rollers appeared, but these were checked readily by hand-picking. Several dustings with sulphur controlled the mildew.

The accompanying report on the behavior of the tea, hybrid tea, and polyantha roses, grown in the Garden in 1920, will

be of interest. The plants were given ordinary garden culture and on that account varieties giving poor results the past season might, with different treatment, prove successful.

TEA, HYBRID TEA AND POLYANTHA ROSES

*ADMIRAL WARD. Growth moderate; foliage plentiful; bloom abundant in spring and fall.

ANTOINE RIVOIRE. Growth poor; foliage fair; bloom free in spring.

BETTY. Growth moderate; foliage plentiful; bloom free.

CHEERFUL. Growth and foliage poor; shy bloomer.

CLOTILDE SOUPERT (Polyantha). Growth moderate; foliage plentiful; bloom abundant.

COLUMBIA. Growth moderate; foliage plentiful; bloom free.

CONSTANCE (Pernetiana). Growth poor; foliage fair; bloom abundant in spring.

*COQUETTE DES ALPES (Hybrid Noisette). Growth strong; foliage plentiful; bloom continuous in summer and fall.

DEAN HOLE. Growth and foliage poor; shy bloomer.

DUCHESS OF ALBANY. Growth moderate; foliage plentiful; bloom free in spring.

*DUCHESS OF WELLINGTON. Growth strong; foliage plentiful; bloom abundant. (A good rose).

EARL OF WARWICK. Growth strong; foliage plentiful; free bloomer.

*ECARLATE. Growth strong; foliage plentiful; bloom abundant.

EDGAR M. BURNETT. Growth, foliage, and bloom poor.

EDWARD MAWLEY. Growth and foliage poor; shy bloomer.

ELLEN WILLMOTT. Growth moderate; foliage and bloom fair.

ETOILE DE FRANCE. Growth moderate; foliage and bloom fair.

*FLORENCE PEMBERTON. Growth strong; foliage plentiful; bloom abundant.

FRANCIS SCOTT KEY. Growth poor; foliage fair; bloom shy.

GENERAL MACARTHUR. Growth moderate; foliage plentiful; bloom fair.

GEORGE C. WAUD. Growth moderate; foliage fair; bloom free in spring.

GEORGE DICKSON. Growth moderate; foliage plentiful; bloom free in spring.

GORGEOUS. Growth moderate; foliage and bloom fair.

GRACE DARLING. Growth, foliage, and bloom poor.

GRANGE COLOMBE. Growth moderate; foliage plentiful; bloom shy.

*GRUSS AN TEPLITZ. Growth strong; foliage plentiful; bloom abundant.

HADLEY. Growth, foliage, and bloom fair.

HARRY KIRK. Growth moderate; foliage fair; bloom shy.

HELEN GOULD. Growth and foliage fair; bloom shy.

*HERMOSA (Bourbon). Growth moderate; foliage plentiful; bloom abundant.

HOOSIER BEAUTY. Growth poor; foliage fair; bloom fair in spring and fall.

IRISH BEAUTY. Growth poor; foliage fair; bloom shy.

JONKHEER J. L. MOCK. Growth moderate; foliage fair; bloom free in spring but shy in fall.

KAISERIN AUGUSTA VICTORIA. Growth moderate; foliage fair; bloom free in spring and fall.
*KATHERINE ZEIMET (Polyantha). Growth moderate; foliage plentiful; bloom continuous.
KILLARNEY. Growth moderate; foliage fair; bloom free in spring.
KILLARNEY (White). Growth moderate; foliage and bloom fair.
*KILLARNEY QUEEN. Growth strong; foliage plentiful; bloom abundant.
*LADY ALICE STANLEY. Growth strong; foliage plentiful; bloom abundant.
LADY ASHTOWN. Growth moderate; foliage and bloom fair.
LADY URSULA. Growth moderate; foliage plentiful; bloom fair.
*LA FRANCE. Growth moderate; foliage plentiful; bloom abundant.
*LA TOSCA. Growth strong; foliage plentiful; bloom abundant in spring and fall.
*LAURENT CARLE. Growth strong; foliage plentiful; bloom free.
LEONIE LAMBERT. Growth moderate; foliage and bloom fair.
LILLIAN MOORE. Growth and foliage moderate; bloom fair.
LOS ANGELES. Growth moderate; foliage fair; bloom free in spring and occasionally during summer. Winter-killed.
LYON ROSE (Pernetiana). Growth, foliage, and bloom poor.
*MME. ABEL CHATENAY. Growth strong; foliage plentiful; bloom free.
MME. BUTTERFLY. Growth moderate; foliage fair; bloom free.
MME. EDOUARD HERRIOT (Pernetiana). Growth, foliage, and bloom poor.
*MME. LEON PAIN. Growth strong; foliage plentiful; bloom abundant.
MME. MARCEL DELANNEY. Growth strong; foliage plentiful; bloom free.
MME. MELANIE SOUPERT. Growth strong; foliage plentiful; bloom free.
MME. SEGOND WEBER. Growth moderate; foliage plentiful; bloom fair.
MAMAN COCHET (Tea). Growth and foliage poor; shy bloomer.
MILADY. Growth poor; foliage and bloom fair.
*MISS CYNTHIA FORDE. Growth strong; foliage plentiful; bloom abundant.
MR. P. L. BAUDET. Growth strong; foliage good; bloom abundant.
*MRS. AARON WARD. Growth moderate; foliage plentiful; bloom abundant.
*MRS. A. R. WADDELL. Growth strong; foliage plentiful; bloom abundant.
MRS. B. R. CANT. Growth and foliage poor; shy bloomer.
MRS. BRYCE ALLEN. Growth, foliage, and bloom poor.
MRS. FRANKLIN DENNISON. Growth strong; foliage plentiful; bloom fair.
MRS. GEORGE SHAWYER. Growth moderate; foliage plentiful; bloom fair.
MRS. WAKEFIELD CHRISTIE-MILLER. Growth moderate; foliage and bloom fair.
MY MARYLAND. Growth moderate; foliage and bloom fair.
OPHELIA. Growth strong; foliage plentiful; bloom fair.
ORLEANS (Polyantha). Growth strong; foliage plentiful; bloom continuous.
PHARISAER. Growth, foliage, and bloom poor.

*RADIANCE. Growth strong; foliage plentiful; bloom abundant. (One of the best roses).
RED-LETTER DAY. Growth, foliage, and bloom fair.
RED RADIANCE. Growth fair; foliage plentiful; bloom fair.
RHEA REID. Growth, foliage, and bloom fair.
RODHATTE (Polyantha). Growth moderate; foliage plentiful; bloom abundant.
ROSITA MAURI. Growth moderate; foliage and bloom fair.
SOUV. DE PRES CARNOT. Growth moderate; foliage plentiful; bloom free in summer and fall.
SUNBURST. Growth and foliage poor; bloom fair in spring.
*WELLESLEY. Growth strong; foliage plentiful; bloom free.
WILLIAM R. SMITH (Tea). Growth, foliage, and bloom fair.
WILLOWMERE (Pernetiana). Growth and foliage fair; bloom fair in spring.

The asterisk (*) indicates varieties that grow most successfully in St. Louis.

In former years a large collection of hybrid tea roses was maintained at the Garden and special beds were devoted to the newer varieties. Due to the failure of some of the roses it has been decided to devote a section of the economic garden to a trial garden where the older roses, which were unsuccessful in the main rose garden, and the newer varieties will be given different soil conditions and individual treatment.

The following varieties will be grown in the main rose garden this season:

TEA AND HYBRID TEA ROSES

Betty
Duchess of Albany
Duchess of Wellington
Ecarlate
Etoile de France
Florence Pemberton
General MacArthur
George C. Waud
Jonkheer J. L. Mock
Kaiserin Augusta Victoria
Killarney Queen
Lady Alice Stanley
Lady Ashtown
Lady Ursula
La France
Laurent Carle
Los Angeles
Mme. Abel Chatenay
Mme. Leon Pain
Miss Cynthia Forde
Mrs. Aaron Ward
Mrs. A. R. Waddell
Mrs. Franklin Dennison
Mrs. George Shawyer
Papa Gontier
Radiance
Souv. de Pres. Carnot
Wellesley

POLYANTHA ROSES

Clotilde Soupert
Katherine Zeimet
Marie Pavic
Orleans
Rodhatte

HYBRID PERPETUALS

Alfred Colomb
Anna de Diesbach
Baron de Bonstetten
Baroness Rothschild
Boule de Neige
Captain Christy
Captain Hayward
Clio
Coquette des Alpes (Hybrid Noisette)

Duchess d' Assuna
Duke of Edinburgh
Duke of Teck
Earl of Dufferin
Eugene Furst
Fischer Holmes
Francois Levet
Frau Karl Druschki
General Jacqueminot
Gloire de Chedane Guinoisseau
Gloire Lyonnaise
Hugh Dickson
J. B. Clark
John Hopper
Magna Charta
Margaret Dickson
Marshall P. Wilder
Mme. Charles Wood
Mme. Gabriel Luizet
Mme. Plantier
Mildred Grant
Mrs. John Laing
Mrs. R. G. Sherman-Crawford
Paul Neyron
Prince Camille de Rohan
Tom Wood
Ulrich Brunner

HYBRID RUGOSAS

Conrad F. Meyer
Nova Zembla

CLIMBERS

American Beauty
Aviateur Bleriot
Crimson Rambler
Dawn
Dorothy Perkins
Goldfinch
Gruss an Teplitz
Hugonis
Mrs. M. H. Walsh
Philadelphia
Dr. Van Fleet
Electra
Excelsa
Farquhar
Silver Moon
Tausendschön
Trier
Yellow Rambler

BAGGING THE BAGWORM.

While the bagworm has been more or less prevalent in St. Louis for a number of years, the unusual number of these pests last spring, with the resulting cocoons, makes it probable that a considerable amount of damage to the trees may be anticipated during the coming season unless some systematic campaign is devised against them. The curious habit of the caterpillar of crawling about in a bag-like case makes it unusually conspicuous, and there are few trees in the city on which a careful inspection will not reveal, attached to the twigs, the old female bags, within which are the eggs for this spring's crop of caterpillars.

Immediately upon the hatching of these eggs the young caterpillar makes its way to the nearest leaf, where it begins to feed and construct a bag for itself. This bag consists of small fragments of leaves and bits of twigs held together by a large amount of silk spun by the caterpillar. The construction of this bag by the young larva is extremely interesting and well worth observing. Because of the soft body of the larva, the protective bag is needed throughout its existence, and as the caterpillar grows the case is constantly enlarged. About the end of August the caterpillar completes its growth

and the bag is promptly attached to a twig. Additional layers of silk are spun within the bag, forming a cocoon, and here the transformation to the pupal stage takes place. In about three weeks after the cocoon is formed the male moth emerges from the base of the bag and flies about seeking the female. The female moth never leaves the bag entirely, although the head emerges from the lower end. Fertilization takes place within the bag, after which the female gradually works her way back into the chrysalis, which she then nearly fills with eggs. After accomplishing this, the female forces her body through the opening in the bag, falls to the ground, and dies.

Damage.—While the chief damage from this worm is, of course, the defoliation of the tree, an investigation of the effect of the constriction of twigs by the bag worm, published in the Seventeenth Report of the Missouri Botanical Garden, by Dr. Hermann von Schrenk, showed that the pressure exerted by the silken bands on twigs of coniferous trees was sufficient to cut off the food supply and that practically no growth took place in the twig on the sides below the bands. The portion of the twig above the band continued to grow for a considerable period, but that ultimately considerable damage might occur in coniferous trees seemed to be probable. In the hardwood trees investigated, with the exception of the locust, the pressure of the band was never great enough to obstruct the passage of elaborated food material. The strength which some of these bands showed was very considerable. The growth energy exerted by the twig, necessary to burst the band, of course varied very much with the strength of the individual band, but actual measurements showed that as high as 162 atmospheres was exerted in one case and it is probable that in many cases at least from 30 to 40 atmospheres pressure was produced.

Collecting the Bags.—Since the eggs of the caterpillar are carried over the winter in the bag, the collection and destruction of these bags before the time of hatching is the most natural method which suggests itself of eradicating the worm. On small trees, which can be thoroughly gone over with the aid of a short ladder or by the use of a light pole pruner, such a method is recommended, provided all of the bags can be removed. However, unless this can be accomplished for all the trees, both large and small, over a very considerable area, results may be more harmful than beneficial, for the reason that at the time the eggs of the bagworm are destroyed, the natural enemies of the caterpillar are likewise obliterated. Various flies which breed within the bag of the bagworm are parasitic upon the caterpillar and, under favorable conditions, are a

very important factor in preventing the rapid spread of this pest. For this reason everything should be done to encourage the growth of the parasites. Of course, if only a small number of the bags is collected, the beneficial parasites which are destroyed might have ultimately been more effective than the elimination of comparatively few bagworm eggs. It is consequently advisable to keep the hand-picked bags in some sort of a receptacle instead of burning them. If a barrel is used for this purpose, it should be covered with a wire netting which will confine the caterpillars as they hatch out, but will permit the numerous parasites to escape and be ready to assist in the control of the bagworms the following year. In general, then, the collecting of the bags is effective only where a comparatively few trees are infected, and is not likely to be of much benefit when the pest is so widespread as it was in St. Louis during the past season. A striking example of the futility of this method is given by the late Professor C. V. Riley. He stated that for two consecutive months he worked attempting to keep a single cedar tree, not more than six feet high, free from caterpillars. Almost every day he found fresh specimens which had been overlooked at the previous visit, and he estimated that this prodigious number of caterpillars was the progeny of not more than two females.

Spraying.—Wherever appliances, capable of reaching all parts of a tree, whatever its size, are available, there is no question but that the use of some arsenical spray offers the only adequate means of combating the bagworm. If carefully carried out, spraying will result in the destruction of all the bag-manufacturing caterpillars so that in the following winter there will be no bags to collect. Paris green has been used with good effect for this purpose, but arsenate of lead, because of its greater adhesiveness which prevents its being easily washed off by rains, is the poison generally employed. Arsenate of lead is usually sold in the form of either a powder or paste, although it may likewise be obtained as a cream. The powder, while suitable for dry spraying, is the worst form to use for wet spraying. This is because the dry powder, on remixing with the water, loses much of its fineness, being relatively coarse and quick-settling. Consequently the paste is the form most generally used at the present time. The pastes vary widely in the fineness of their particles as well as in the character of their chemical properties. It is very desirable that a good grade of arsenate of lead be obtained, for if arsenate of soda be present, it will invariably scorch the leaves. When mixed with the right quantity of water, it should require a considerable time to settle, since

this will give a test of the fineness of the particles of which the paste is made up.

The most important point in buying arsenate of lead in any form is to know its strength in terms of arsenic oxide. As the poisonous properties of the substance are due to the arsenic present and not to the lead, its efficiency from this point of view depends upon the arsenic content. Most reliable firms will guarantee the arsenic strength of the particular brand sold by them. Fifteen per cent of arsenic is an average strength of the paste, and this content is assumed in directions given for mixing the spray.

Another element entering into the efficiency of any spray used is the fineness of the jet as it is applied and the amount put on each tree. Where a very fine spray jet is used, it is sometimes desirable to double the strength of the arsenate of lead and use but half the normal amount on each tree. Too much stress cannot be laid upon the importance of using a nozzle which will give the finest possible spray. The idea is to envelop the tree in a fog or mist. If the droplets are too large the liquid drips off the leaves, carrying the arsenate of lead with it, and the efficiency of the operation is greatly reduced, besides causing an undue loss of material. It is impossible to give more than approximate figures as to the proper amount and strength of spray, since so much depends upon the character of the spray, the method of application, as well as the size of the tree and the state of its foliage. The following table, however, will furnish a fair idea of what is necessary to bringing about satisfactory results.

Spread of tree	Amount of spray for 100 trees	Weight of arsenate of lead paste for 100 trees
7 feet	200 gallons	8 pounds
10 feet	270 gallons	11 pounds
15 feet	460 gallons	18½ pounds
20 feet	720 gallons	29 pounds
25 feet	1120 gallons	45 pounds
30 feet	1500 gallons	60 pounds
35 feet	2200 gallons	88 pounds
40 feet	2500 gallons	100 pounds

For a smaller number of trees the approximate amount of spray and the number of pounds of arsenate of lead needed can be easily figured by taking the fraction obtained by dividing 100 by the number of trees to be sprayed.

Time of Spraying.—Owing to the great variation in the time at which trees leaf in different seasons, it is impossible to

give any definite date on which the spraying should begin. The best rule is to begin to spray as soon as possible after the pest is first noticed. Much less spray is needed when the leaves are small and the young caterpillars are more quickly killed. Furthermore, it is extremely desirable to destroy the pest before serious damage to the young foliage is done. The amount of arsenic necessary to kill a full-grown caterpillar apparently varies greatly. It has been estimated, however, that a quantity of the paste equal to 1/2000 of the body weight of the caterpillar will stop its feeding in an hour or two and kill it in a few days. Even though poisoned caterpillars appear to recover, they often fail to pupate successfully.

NOTES

Dr. E. V. Wilcox, of the agricultural staff of Country Gentleman, visited the Garden recently.

Professor H. M. Hall, of the Carnegie Institution of Washington, recently spent a day at the Garden consulting the herbarium and library.

On March 10, Dr. Hermann von Schrenk, Pathologist to the Garden, with other members of the Conservation Committee, visited Gov. Hyde in the interest of legislation leading to forest development by the state.

Mr. G. H. Pring, Horticulturist to the Garden, visited the International Flower Show, at New York, March 18-20, and on March 20 gave an illustrated lecture at the Brooklyn Botanic Garden on "The Missouri Botanical Garden."

Dr. Hermann von Schrenk attended the Central States Forestry Conference at the Union League Club, Chicago, as a delegate for Missouri and was appointed a member of the executive committee and chairman of the Missouri delegation.

The fourth number of Volume VII of the Annals of the Missouri Botanical Garden has recently been issued with the following contents:

"Studies in the Physiology of the Fungi. XI. Bacterial Inhibition by Metabolic Products." W. H. Chambers.

"The Nutritive Value of the Food Reserve in Cotyledons." B. M. Duggar.

"Titration Curves of Certain Liquid Culture Media." J. L. Karrer and R. W. Webb.

"The Use of 'Insoluble' Salts in Balanced Solutions for Seed Plants." B. M. Duggar.

STATISTICAL INFORMATION FOR FEBRUARY, 1921

GARDEN ATTENDANCE:

Total number of visitors.....11,737

PLANT ACCESSIONS:

Total number of plants and seeds received as gifts....	33
Total number of plants received in exchange.....	400

PLANT DISTRIBUTION:

Total number of plants distributed in exchange.....	21
Total number of seed packets distributed in exchange..	2

LIBRARY ACCESSIONS:

Total number of books and pamphlets bought.....	22
Total number of books and pamphlets donated.....	163

HERBARIUM ACCESSIONS:

By Purchase—

Rev. John Davis—Plants of Missouri.....	700
A. A. Heller—Plants of Oregon and California.....	170

By Gift—

F. Agrelius—*Koelreuteria paniculata* Laxm.....	1
Dr. R. P. Burke—Fungi of Alabama.....	20
H. Harold Hume—*Caryopteris divaricatus* Maxim. and *Cenchrus carolinianus* Walt. from Florida.....	2
Roy Latham—*Stereum versiforme* B. & C.....	1
A. T. Speare—*Septobasidium Spongia* from Okeechobee, Florida	1
Dr. R. Thaxter—*Corticium centrifugum* Lev. from Maine	1

By Exchange—

Arnold Arboretum—Conifers of Formosa, collected by E. H. Wilson.....	25
Ira W. Clokey—Plants of Colorado.....	240
University of California, by Professor W. A. Setchell—Fragments of type and authentic specimen of *Caulanthus* sp.	2
U. S. National Herbarium—Photographs of types of *Atriplex*	8
Total	1,171

The Garden is open to the public every day in the year, except New Year's, Fourth of July, Labor Day, and Christmas—week days from 8:00 A. M. until one-half hour after sunset; Sundays from December to April, 1:00 P. M. until sunset, from April to December, 2:00 P. M. until sunset.

The main entrance to the Garden is located at Tower Grove Avenue and Flora Boulevard, on the Vandeventer Avenue car line. Transfer south from all intersecting lines.

STAFF
OF THE MISSOURI BOTANICAL GARDEN

Director,
GEORGE T. MOORE.

BENJAMIN MINGE DUGGAR,
Physiologist in charge of Graduate Laboratory.

EDWARD A. BURT,
Mycologist and Librarian.

HERMANN VON SCHRENK,
Pathologist.

JOANNE L. KAERCHER,
Research Assistant.

JESSE M. GREENMAN,
Curator of Herbarium.

KATHERINE H. LEIGH,
Secretary to the Director.

NELL C. HORNER,
Editor of Publications.

G. H. PRING,
Horticulturist.

JOHN NOYES,
Landscape Designer.

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BOARD OF TRUSTEES
OF THE MISSOURI BOTANICAL GARDEN

THE ORIGINAL MEMBERS WERE DESIGNATED IN MR. SHAW'S WILL AND THE BOARD SO CONSTITUTED, EXCLUSIVE OF THE *EX-OFFICIO* MEMBERS, IS SELF-PERPETUATING

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DANIEL S. TUTTLE,
Bishop of the Diocese of Missouri.

CHARLES A. ROE, Secretary.

NIAGARA FALLS, U. C.

THIS IS TO CERTIFY THAT

Mr. Shaw

HAS PASSED BEHIND THE GREAT

FALLING SHEET OF WATER,

TO TERMINATION ROCK,

Being 230 ft. behind the Great Horse-Shoe Fall.

Given under my hand, at the office of the General Register of the names of visitors at the Table Rock,

This 10th day of July 18[illegible]

Sarah Starkey

REPRODUCTION OF CERTIFICATE FOUND IN BACK OF MR. SHAW'S DIARY.

Missouri Botanical Garden Bulletin

Vol. IX St. Louis, Mo., April, 1921 No. 4

EXTRACTS FROM MR. SHAW'S DIARY

Mr. Shaw, in all of his business dealings, was evidently unusually painstaking and systematic, keeping a most elaborate set of books and saving every receipt or other bit of paper which in any way might have a bearing on any of his transactions. In addition, particularly while traveling, he kept a careful diary which is full of most interesting comments concerning his journey. The only diary pertaining to travel in this country seems to be one taken in July, 1840, when he started from St. Louis to Rochester, New York, preliminary to his first trip abroad the latter part of that year. While not of much historical importance, it seems worth while that Mr. Shaw's comments on conditions in this country eighty years ago should be preserved, and the following extracts from his diary, in so far as it refers to travel in this country, are hereto appended. It is interesting to note that even at this early period Mr. Shaw had a keen eye for the beauties of nature and that he "much admired the house and gardens of a Scotch gentleman."

The spelling, capitalization, and punctuation are given exactly as written by Mr. Shaw.

"JOURNAL OF A VOYAGE FROM ST. LOUIS TO ——— 1840

"July 11. After a preparatory arrangement of my affairs for an absence of 18 or 20 months this day took passage on Steamer Fayette for Peru the highest navigable point on the Illinois River and about three hundred miles from St. Louis —was much disappointed in the appearance of the towns and settlements on the Illinois some of which appear rather now going to decay than advancing in prosperity.

"July 13th. Landed at Peru and immediately got extra stage coaches to carry us to Chicago a distance of one hundred miles—we were eighteen passengers in all nine in each stage and being fine weather had a most agreeable ride across the prairies which at this season are covered with verdure and of vast extent—passed or forded Fox river and afterward the Des Plaines both tributaries of the Illinois—the road is

good and for the most part level and the country favourable for the construction of the canal undertaken by the state of Illinois to connect Lake Michigan with the river—the work is said to be already half completed and some progress making to finish it—when within nine miles of Chicago came to a low swampy country which occupies several hours to pass.

"July 14th—arrived at Chicago at 9½ A. M. the Lake Steamer Illinois had left half an hour only before our arrival —were of course much disappointed and have to wait two days for the Great Western.

"15th passed at Chicago—rather a dull place—a good hotel called the Lake House—and the air from the lake cool and refreshing to those coming from a southern climate.

"16th. took passage on board the fine Lake Steamer Great Western—distance to Buffaloe computed at 1200 miles—from the novelty found lake travelling quite agreeable the coolness of the air and purity and clearness of the water quite a contrast to that of the Mississippi.

"17th. Had an interesting view of the Manitou and other islands at head of Lake Michigan—all as well as the main shore appeared uninhabited, except the west side where we have passed several little towns in the territory call Wisconsin.

"18th, at one o'clock this morning came to at the Island of Michilimakinac—being a clear moonlight went on shore intending to have left the boat and remained a couple of days but found the accomodations for travellers very indifferent —found a number of Indians encamped—they had arrived the day before in their bark canoes—the place has much the appearance of a Canadian village—the Fort is on a commanding position above the town—the place is celebrated for the purity of its climate and tho in the midst of summer found a great coat very comfortable—at half past ten in the morning observed a brightness in the sky in one direction which first took for Aurora Borealis but the brilliancy increasing found it to be in the East and to be

'Aurora fairest goddess of the morn'

"19th. Sail'd thro the wide spread waters of Lake Huron and at ten o'clock this morning arrived at the city of Detroit —being Sunday morning found the good people at church— went in for a few minutes to the Presbyterian—and then to the Catholic church—they were singing the anthem, the female voices were pleasing and unaffected—there are a number of paintings, the most conspicuous next to the altar piece

(a Holy family) is a robust figure of St. Peter with the keys ———lastly called in at the Episcopal church where everything appeared to be in perfect order and a most respectable congregation—left Detroit in the evening and passed down the river St. Clair the banks of which are adorned with cottages and orchards to Lake Erie.

"20th—before rising from our confined berths have landed at the Pici at the port of Cleveland in Ohio—a bustling place of trade—and a great deal of the mock magnificent in their recently erected houses and hotels—met a heavy swell in the lake this evening which made the upper cabins of the Great Western roll dreadfully.

"21st—at 2 o'clock this morning came to the termination of our lake voyage by arriving at the flourishing port of Buffaloe—so increased as scarcely to be recognized as the Buffaloe of 15 years ago—and evidences of a more extensive commerce than have yet observed at any place since leaving St. Louis —the American Hotel a magnificent building and others of much magnificence and splendour Buffaloe is indebted to the enterprise of a forger on a scale of grandeur on a par with his buildings—he is now in the penitentiary and the name of Rathburn will long remain a terror to evildoers.— came by stage to Battavia and thence by Rail Road to Rochester where I arrived in a thunderstorm and at last have the pleasure of joining my dear old parents—an obligation that I have had in my mind so many years—am very thankful to find them in good health and to a good providence that has once more restored them to me—my sisters also in appearance much better than from previous ill health had any expectation of finding—am much pleased with their most comfortable little dwelling which I have facetiously named "Economy Hall"—also with their little circle of friends to whom there appears to be a tried and sincere attachment.

"22nd and 23rd—spent with my family at Rochester.

"26th—Started on a pleasure excursion to the falls of Niagara in company with mother, sister S. and Miss Julia Guernsey—arrived same day at Buffaloe—journey pleasant—part by Rail Road and part by Stage.

"27th—passed at Buffaloe at an elegant hotel called the American House—from the cupola on the roof had an extensive view of the Lake and surrounding country—scene enlivened by the departure of steamer for the upper lakes and arrival of sloops at the pier. Buffaloe has much the appearance and bustle of a small seaport—left in the evening for the Falls of Niagara—rode along the shore of Niagara River—the

country flat—pleasant prospect of the river and the celebrated Navy Island which is still nearly covered with timber.

"28th and 29th—passed at Niagara in viewing the Falls from the American and Canada shore—descended the cliff at Goat Island and made a showery incursion under the principal cataract—found the noise tremendous and deafening—in the afternoon of the 29th left the falls and its genteel company and visited the rapids on the river below called the whirlpool—also the deep and gloomy chasm in the rock—the Devils Hole—the River Niagara flowing as a rapid torrent through a deep channel of rocks is a romantic sight—seven miles from the cataract it arrives at the plain level country and assumes the breadth and depth of a grand and navigable river at Lewiston where we arrived the same evening and remained all night—the noise of the great fall still as audible as in the immediate vicinity.

"30th—early this morning (and before the ladies arose) took a solitary walk to regain the rising ground and obtain another extensive view of the surrounding country on both sides of the river—and opposite the monument erected in Queenstown Heights in memory of the British General Brock who fell in the engagement on the same spot in the war of 1812—returned by Rail Road to Lockport—thence by the natural alluvial turnpike called the ridge road to Rochester passing Brockport to the right and thru a fruitful and highly cultivated country—a country rich in the productions of Pomona and Ceres—arrived at my Father's house late in the evening after a days journey of nearly a hundred miles.

"1 & 2 Aug^{t}—on sunday went to church in the morning —after the usual prayers of the Episcopal church heard an eloquent sermon by the learned and reverend Doct. Whitehouse—in the evening took a ride with our friend Mr. Delano in his gig to the lower falls of the Genesee river—passing thro that Irish suburb of Rochester called Dublin—the lowness of the river took off somewhat of the grandeur of the Genesee falls which if they were not so near the thundering Niagara might attrack more attention. The Genesee leaps off the same bed of rocks as its greater sister.

"3rd took an excursion with my dear little sister Caroline leaving Rochester in the Easter Stage and with agreeable company we passed thro Pittsford and Canandaighua to Geneva on Lake Seneca—one of the lakes tho secondary in size—superior in beauty to the great Northern lakes—remained here for the night—in the evening joined the audience of the Pres^{n} church and listened to a poetical composition

by the author (Mr. Street) and an address to the college boys by a Rev. Mr. ———— of N Yk—a man of good plain sense but unpolished in his manner and out of place as a literary speaker.

"Aug^{t} 4th. Went by a short and pleasant ride thro Waterloo and Seneca Falls to Cayuga bridge a wooden structure to cross the foot of the Cayuga Lake—arrived about noon and in less than half an hour embarked on the beautifull lake in an elegant steamer—a delightfull voyage of four hours up the lake the shores of which are high and gently undulating—diversified with farms and villages—Aurora (fairest goddess of the morn) is the principal—the lake is terminated or rather commences in a low swampy valley—but behind the trees and shrubbery the town of Ithaca suddenly opened to our view (popu^{n} 5000) a showing tavern with corinthian columns a number of churches and a number of retail mercantile concerns bespeak a place of some importance—it is singularly surrounded with lofty hills on every side—in the evening took a stroll to the top of one of them and had a glorious and brilliant sunset—the fineness of the evening had allured out a number of the fair sex—the gallant manners and dress of some of the younger and more handsome very refreshing to my bachelor eyes.

"5th roused at one o'clock both my sister & self by the departure of stages but ours did not leave until 3 o'clock—a chilly morning and in passing the lofty hills to the head of Lake Seneca where we are bound—found the necessity of always having an overcoat in traveling—the distance is 25 miles thro a wild country and bad roads to the Seneca Lake where we once more embarked on the placid waters—the scenery on the banks very similar to the Cayuga—width from 1-2 miles and length about 40—at 3 o'clock came again in sight of the beautifull village and hanging gardens of Geneva.

"6th spent the afternoon in visiting a lady of my sister's acquaintance at Canandaighua where we arrived by stage in a few hours from Geneva—much admired the house and gardens of a Scotch gentleman Mr. Gress—this village and Geneva are the prettiest places I have yet seen this side the Atlantic—they appear to be the residences mostly of persons of retired circumstances living comfortably & in some elegance.

"Aug 7th left Canandaighua and returned by same route we went—back to Rochester—the village of Pittsford appears in the same condition as to proport^{n} and improvements at 15

years ago when it was the residence of my dear parents and sisters.

"Aug^{t} 8th to 18th spent at Rochester with my family and regret that I cannot conveniently remain longer with them for after such a long absence it is with regret that I leave them so soon—but the winter is approaching and my object is to go to Italy and there to pass the greater part of winter —on the 18th took leave of my aged parents once more—my sister Sarah accompanies me to spend a few weeks travelling about in the U States it being our intention to visit N York —Phila—Baltimore & Washington & perhaps Boston—our first days traveling was very hot, dusty, disagreeable—nine of us crowded in a stage coach for 60 miles to Auburn—then 80 more pleasantly and swiftly to Utica on a Rail Road where we arrived late in the evening and put up at a very crowded hotel (Buggs's).

"19th after a refreshing nights rest and breakfast started in a hired barouche to visit Trenton Falls"

HARDY EXOTIC PLANTS SUITABLE FOR THE GARDENS OF MISSOURI AND ADJOINING STATES

(Continued from February Bulletin)

III. SHRUBS WITH CONSPICUOUS FLOWERS

Botanical name	Common name	Approx. height	Color of flowers	Approx. time of bloom	Habitat
Berberis vulgaris	European barberry	4-8′	Yellow	May-June	Europe to Asia
Berberis vulgaris var. *atropurpurea*	Purple-leaved barberry	.....	Purple foliage	.....	.....
Buddleia Davidii	David's buddleia	3-5′	Purple	Aug.-Oct.	China
Buddleia japonica	Japanese buddleia	3-6′	Lilac	July-Sept.	Japan
Buddleia Lindleyana	Lindley's buddleia	3-6′	Lilac	Aug.-Sept.	China
Caragana arborescens	Pea tree	6-12′	Yellow	May-June	Siberia
Caryopteris Mastacanthus	Blue spiraea	1-2′	Blue	Apr.-May	China, Japan
Catalpa Bungei	Chinese catalpa	4-10′	White	June	China
Cercis chinensis	Chinese red-bud	4-10′	Rose-pink	Apr.-May	China
Colutea arborescens	Bladder senna	4-10′	Yellowish red	June-July	Europe to Africa

Botanical name	Common name	Approx. height	Color of flowers	Approx. time of bloom	Habitat
Cornus alba var. *sibirica*	Red-branched dogwood	3-6′	White	May-June	Siberia, China
Cornus Mas	Cornelian cherry	5-10′	Yellow	Mar.-Apr.	Europe to Orient
Cornus sanguinea	Red-branched dogwood	3-6′	White	May-June	Europe to Orient
Cotoneaster nummularia var. *racemiflora*	Cotoneaster	3-8′	White	Apr.-May	Africa to Asia
Crataegus monogyna var. *rosea*	Hawthorn	10-15′	Rose	Apr.-May	Europe to Africa
Crataegus Oxyacantha	English hawthorn	6-15′	White	Apr.-May	Europe
Cydonia japonica	Japanese quince	5-10′	Scarlet	May	China, Japan
Cytisus scoparius	Scotch broom.	4-8′	Yellow	May-June	S. Europe
Deutzia gracilis	Deutzia	2-3′	White	May-June	Japan
Deutzia scabra	Deutzia	3-6′	White	May-June	China, Japan
Diervilla candida	White-flowered weigelia	3-5′	White	May-June	Gardens
Diervilla floribunda	Weigelia	3-6′	Pinkish purple	May-June	Japan
Diervilla floribunda var. *grandiflora*	Weigelia	2-6′	Pinkish white	May-June	Gardens
Diervilla florida	Weigelia	4-6′	Rose	May-June	N. China
Diervilla hybrida "Eva Rathke"	Weigelia	3-6′	Deep carmine-red	May-June	Gardens
Elaeagnus longipes	Japanese oleaster	4-8′	Yellow-ish white	April-May	China to Japan
Elaeagnus umbellata	Oleaster	4-10′	Yellow	May-June	Japan
Evonymus alata	Evonymus	6-10′	Pinkish purple	May-June	China, Japan

Botanical name	Common name	Approx. height	Color of flowers	Approx. time of bloom	Habitat
Evonymus europaea	Strawberry bush	8-15′	Pinkish purple	May-June	Europe to Asia
Exochorda Albertii	Pearl bush	4-8′	White	May	Turkestan
Forsythia intermedia	Golden-bell	3-8′	Yellow	Mar.-Apr.	China, Japan
Forsythia suspensa	Golden-bell	3-8′	Yellow	Mar.-Apr.	China
Forsythia suspensa var. *Fortunei*	Fortune's golden-bell	4-8′	Yellow	Mar.-Apr.	China
Forsythia viridissima	Golden-bell	4-10′	Yellow	Mar.-Apr.	China
Genista tinctoria	Dyer's broom	1-3′	Yellow	June	Europe to Asia
Hibiscus syriacus	Althaea	6-12′	Rose or purple	June-Oct.	Asia
Hibiscus syriacus varieties	Althaea		Blue-purple, violet, red, flesh, white		
Hydrangea paniculata	Hardy hydrangea	3-6′	White	July-Aug.	Japan
Hydrangea paniculata var. *grandiflora*	Hydrangea	3-6′	White	July-Sept.	Japan
Kerria japonica	Japanese rose.	2-5′	Yellow	May-June	China
Ligustrum amurense	Amoor privet	4-10′	White	May	China, Japan
Ligustrum Ibota	Privet	4-6′	White	May	China, Japan
Ligustrum Ibota var. *Regelianum*	Regel's privet.	3-10′	White	May	China, Japan
Ligustrum ovalifolium	California privet	4-10′	White	May	Japan
Ligustrum vulgare	European privet	6-12′	White	May-June	Europe to Asia
Lonicera alpigena	Bush honeysuckle.	4-6′	Yellowish red	Apr.-May	Europe to Asia
Lonicera chrysantha	Bush honeysuckle.	4-8′	Yellowish	Apr.-May	Siberia
Lonicera fragrantissima	Fragrant bush honeysuckle.	4-6′	Yellowish white	Mar.-May	China
Lonicera Morrowii	Morrow's bush honeysuckle.	4-6′	Yellowish	May-June	Japan

Botanical name	Common name	Approx. height	Color of flowers	Approx. time of bloom	Habitat
Lonicera Ruprechtiana	Bush honeysuckle.	6-12′	White	May-June	Manchuria
Lonicera Standishii	Bush honeysuckle.	4-6′	Pinkish	Mar.-Apr.	China
Lonicera tatarica	Tartarian bush honeysuckle.	3-8′	Pinkish white	May-June	Russia
Magnolia obovata	Magnolia	10-15′	White and purple	May-June	China, Japan
Magnolia Soulangeana	Japanese magnolia	10-15′	White and purple	Apr.-May	Japan
Magnolia stellata	Star magnolia.	6-10′	White	Mar.-Apr.	China
Paeonia Moutan	Tree peony	2-3′	Various colors	May-June	China
Philadelphus coronarius	Mock orange	6-12′	White	May-June	Europe
Philadelphus Falconeri	Mock orange	6-12′	White	May	Japan
Philadelphus pekinensis	Chinese mock orange	3-5′	White	May-June	N. China
Prunus japonica	Flowering almond	3-5′	Double pink and white	May	China, Japan
Prunus tomentosa	Japanese cherry	4-6′	Rose	May	China, Japan
Prunus triflora	Japanese plum	8-15′	White	Apr.-May	Japan
Prunus triloba	Flowering plum	4-6′	Pink or rose	Apr.-May	China
Pyrus Toringo	Dwarf crab	6-10′	White or bluish	Apr.-May	Japan
Pyrus floribunda	Flowering crab	6-15′	Rose	May	Japan
Rhodotypos kerrioides	White kerria	3-5′	White	May	Japan
Rhus Cotinus	Smoke bush	6-10′	Purple	May-June	Europe to Asia
Rhus semialata var. *Osbeckii*	Osbeck's sumac	8-10′	White	July	Japan
*Rosa**	Roses				

*Roses were taken up in the March BULLETIN.

Botanical name	Common name	Approx. height	Color of flowers	Approx. time of bloom	Habitat
Sambucus nigra	Elder	3-6′	White	June-July	Europe
Sambucus nigra var. *aurea*			Leaves yellow		
Sambucus nigra var. *laciniata*			Leaves finely dissected		
Securinega ramiflora	Securinega	3-6′	Greenish white	July-Aug.	Asia
Sorbaria Aitchisonii	Sorbaria	6-8′	White	July-Sept.	Asia
Sorbaria grandiflora	Sorbaria	1-3′	White	June-July	Siberia
Sorbaria sorbifolia	Sorbaria	3-5′	White	June-July	Asia
Spiraea albiflora	Spiraea	1-1½′	White	July-Aug.	Japan
Spiraea arguta	Spiraea	4-6′	White	Apr.-May	Gardens
Spiraea bracteata	Spiraea	4-8′	White	May	Japan
Spiraea Bumalda	Spiraea	1-2′	Pink	July-Aug.	Gardens
Spiraea Bumalda var. *"Anthony Waterer"*	Anthony Waterer's spiraea	1-2′	Crimson	July-Aug.	Gardens
Spiraea decumbens	Trailing spiraea	6″-1′ (trailing)	White	May-June	Europe
Spiraea prunifolia	Plum-leaved bridal wreath	3-6′	White	May	China, Japan
Spiraea Thunbergii	Thunberg's bridal wreath	3-4′	White	Apr.-May	China, Japan
Spiraea trilobata	Three-lobed bridal wreath	2-4′	White	May-June	Asia
Spiraea Van Houttei	Van Houtte's bridal wreath	3-5′	White	Apr.-May	Gardens
Staphylea Bumalda	Bladder-nut	4-6′	White	Apr.-May	Japan
Staphylea Colchica	Bladder-nut	4-8′	White	May-June	Caucasus
Staphylea pinnata	Bladder-nut	8-15′	Greenish white	May-June	Europe to Asia
Stephanandra flexuosa	Stephanandra	2-4′	White	June	Japan
Styrax japonica	Styrax	8-15′	White	June	China, Japan
Syringa chinensis	Chinese lilac	6-8′	Reddish purple	May	China

Botanical name	Common name	Approx. height	Color of flowers	Approx. time of bloom	Habitat
Syringa Josikaea	Lilac	6-10′	Violet	June	Hungary
Syringa persica	Persian lilac	4-10′	Lilac	May-June	Asia
Syringa villosa var. *Emodi*	Lilac	3-6′	White	June-July	Asia
Syringa vulgaris and varieties	Common lilac.	6-10′	White, reddish, purple	Apr.-May	Europe to Asia
Tamarix africana	African tamarix	10-20′	Pinkish	May-June	Europe
Tamarix gallica	Tamarix	10-20′	Pinkish	May-June	Europe
Viburnum Carlesii	Viburnum	3-5′	Rose-pink	May	Japan
Viburnum dilatatum	Viburnum	6-10′	White	May-June	China, Japan
Viburnum Lantana	Wayfarer's tree	8-15′	White	May-June	Europe to Asia
Viburnum Sieboldii	Viburnum	8-18′	White	June	China, Japan
Viburnum tomentosum	Viburnum	6-8	White	June	China, Japan
Vitex Agnus-castus	Chaste tree	3-5′	Purple	May-June	Europe to Asia
Vitex Agnus-castus var. *alba*	Chaste tree		White	May-June	Europe to Asia
Vitex Agnus-castus var. *caerulea*	Chaste tree		Blue	May-June	Europe to Asia
Xanthoceras sorbifolia	Xanthoceras	10-20′	White	May-June	China

NOTES

A part of the senior class of the library school of the University of Illinois visited the Garden library, April 1, during a tour of the libraries of St. Louis.

Mr. L. P. Jensen, Arboriculturist to the Garden, gave an illustrated lecture on "The Principles of Landscape Gardening" before the St. Louis Association of Gardeners, March 9, and before the St. Louis Florists' Club, March 16.

Mr. G. H. Pring, Floriculturist to the Garden, gave a lantern-slide talk, April 6, before the St. Louis Association of Gardeners, and April 14, before the St. Louis Florists' Club on "The International Flower Show of New York."

Dr. George T. Moore, Director of the Garden, spoke before the Men's Club of St. Michael and All Angels Church, March 31, on "Gardens, the Weather, and the Soil," and before the Graduate Club of Washington University, April 18, on "Technical Botany."

Recent visitors to the Garden include Mr. L. W. Durrell, of the Missouri Fruit Experiment Station, Mountain Grove,

Missouri, and Dr. D. T. MacDougal, Director Botanical Research of the Carnegie Institution of Washington, Desert Laboratory, Tucson, Arizona, April 16.

Miss E. M. Wakefield, F. L. S., assistant in Mycology in Kew Herbarium, England, visited the Garden March 27–April 3, consulting the mycological collections in the Garden's and Dr. Burt's herbaria and the rarer mycological works in the library. During the winter Miss Wakefield was engaged in Government work in plant pathology in Barbados and neighboring islands of the West Indies. She is now visiting the principal centers of mycological activity in the United States and Canada before returning to Kew.

From an article in "The Park International" for March, 1921, entitled "Park Architecture," under the sub-head "Setting":

"In developing the setting it should be kept in mind that the glass element is more out of keeping with natural scenery than with the building elements which adjoin the park. A setting such as one finds in the Missouri Botanical Garden where the main palm house is placed well within the park but as the terminal feature of an important boulevard leading to it is an excellent solution of the problem. A house of glass is such an absolutely artificial object lacking even the basic natural element of solidity that it needs a certain transitional formality of surrounding instead of close juxtaposition with natural conditions. This indicates the advantages of terraces and display gardens. If a display house is to draw visitors during the winter the designer is vitally concerned when, in approaching the buildings, the unpleasant aspects of the season are emphasized by the emptiness of pools, the bareness of flower beds, or the graceless forms of straw-covered bushes, no matter how wonderful the pools, parterres or rose gardens may have been at the proper season. These considerations would indicate that the outdoor display of plant material should be so arranged that its off-stage dishabille will not be seen between the acts. Surely the entrance side of a group can be kept sightly at all seasons with three other sides, access to which can be controlled for the seasonal display of perishable material. These points are raised in the architectural discussion so that the designer of a group will realize that the setting of a structure is a matter for his own consideration and not for a subsequent happenstance development."

Two views of the main range of conservatories, reproduced from the book of views of the Garden, recently issued, were used in connection with this article.

From Gardeners' Chronicle, Vol. XXV, No. 2, February, 1921.

"When pondering greenhouse matters, the question sometimes arises as to whether we are getting the most out of our greenhouses by the prevailing system of growing plants in pots. Those who attended the 1920 convention of the association (National Associa-

tion of Gardeners) at St. Louis, could not fail to have been impressed with the pleasing showing made in those greenhouses of the Missouri Botanical Garden where benches were eliminated and the collections planted directly in the soil. Even when the material used did not possess any particular intrinsic beauty, such as some of the plants of economic value or those of purely botanical interest, a pleasing effect was produced. Such desirable results may be attributed to several factors. In the first place, planting directly in solid beds provides sufficient soil for plant roots to ramble freely. This, especially in the case of the stronger growing subjects, enables growth to be made which more nearly approximates what one would expect in nature and is in striking contrast to the results obtained when the plants are starved in pots. Secondly, one is spared the distractions occasioned by obtrusive benches and inartistic pots. Thirdly, it is possible, provided those responsible have sufficient strength of mind to avoid overcrowding and to rigorously sacrifice when crowding does occur, to obtain results on a small scale comparable to the garden pictures to be seen in the outdoor garden when it has been laid out by a landscape artist with due regard to composition.

"We must admit there are difficulties to be faced to achieve this desirable result, and also disadvantages connected with a planted out house, but it is maintained that in many cases the advantages to be gained make it well worth while to take the extra thought which will result, partially at least, in eliminating these drawbacks. There is one obstacle to a successful landscape composition in a greenhouse that can scarcely be eliminated, and that is the house itself. We can never hope to entirely relegate to the background the house structure, and one must be reconciled to the feeling that the glass is there, but much can be done by skillful planting, especially when the house is of good size, to make it less obtrusive."

STATISTICAL INFORMATION FOR MARCH, 1921

GARDEN ATTENDANCE:

Total number of visitors.....19,975

PLANT ACCESSIONS:

Total number of packets of seed received in exchange.. 275
Total number of plants received in exchange..... 181

LIBRARY ACCESSIONS:

Total number of books and pamphlets bought..... 99
Total number of books and pamphlets donated..... 136

HERBARIUM ACCESSIONS:

By Purchase—
D. Lewis Dutton—Plants of Vermont..... 160

By Gift—
Field Museum of Natural History, by Dr. C. F. Millspaugh—Fungi of Santa Catalina Island, California... 52
H. A. Lee—Fungi of Luzon, Philippine Islands..... 17

Dr. H. von Schrenk—*Peridermium californicum* from California and *Urnula craterium* from Arkansas....	2
Dr. C. L. Shear—Specimens of *Endothia* illustrating monograph by author.....	9
Dr. R. A. Thaxter—Fungi of New England.....	8
By Exchange—	
Botanical Museum, University of Helsingfors, by Dr. Harold Lindberg—Plants of Finland.....	1,000
Carnegie Museum, Pittsburgh, by Dr. O. E. Jennings—Plants of Pennsylvania.....	200
Dr. H. Hoehne—Type material of a new orchid, *Yolanda restrepiodes* Hoehne, from Brazil.....	1
Total	1,449

The Garden is open to the public every day in the year, except New Year's, Fourth of July, Labor Day, and Christmas—week days from 8:00 A. M. until one-half hour after sunset; Sundays from December to April, 1:00 P. M. until sunset, from April to December, 2:00 P. M. until sunset.

The main entrance to the Garden is located at Tower Grove Avenue and Flora Boulevard, on the Vandeventer Avenue car line. Transfer south from all intersecting lines.

STAFF
OF THE MISSOURI BOTANICAL GARDEN

Director,
GEORGE T. MOORE.

BENJAMIN MINGE DUGGAR,
Physiologist in charge of Graduate Laboratory.

EDWARD A. BURT,
Mycologist and Librarian.

HERMANN VON SCHRENK,
Pathologist.

JOANNE L. KARRER,
Research Assistant.

JESSE M. GREENMAN,
Curator of Herbarium.

KATHERINE H. LEIGH,
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Editor of Publications.

G. H. PRING,
Horticulturist.

JOHN NOYES,
Landscape Designer.

L. P. JENSEN,
Arboriculturist.

PAUL A. KOHL,
Floriculturist.

P. C. BRAWNER,
Painter.

W. F. LANGAN,
Engineer.

H. VALLENTINE,
Construction.

MISSOURI BOTANICAL GARDEN BULLETIN

Vol. IX MAY, 1921 No. 5

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BOARD OF TRUSTEES
OF THE MISSOURI BOTANICAL GARDEN

THE ORIGINAL MEMBERS WERE DESIGNATED IN MR. SHAW'S WILL AND THE BOARD SO CONSTITUTED, EXCLUSIVE OF THE *EX-OFFICIO* MEMBERS, IS SELF-PERPETUATING

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VIEW OF MAIN ENTRANCE FROM FLORA BOULEVARD.
(Jamieson and Spearl, architects.)

Missouri Botanical Garden Bulletin

Vol. IX St. Louis, Mo., May, 1921 No. 5

DEDICATION OF THE NEW MAIN ENTRANCE

The dedication of the new main entrance, to replace the old edifice built by Mr. Shaw in 1858, was held under the colonnade of the new gateway at one o'clock, May 10, 1921. The gateway was decorated with American flags, and a platform was erected on which the members of the Board of Trustees were seated. Mr. Shaw's portrait, draped with flags, occupied the center of the space immediately back of the platform, facing the audience. The attendance indicated a gratifying interest in the ceremony. Mr. Edwards Whitaker, President of the Board of Trustees of the Missouri Botanical Garden, presided, and after an invocation by the Rev. Dr. John S. Bunting, Rector of the Church of the Ascension, made the following remarks:

"May I not venture the assertion that few within the hearing of my voice can remember back sixty-three years when Mr. Henry Shaw built an entrance on this spot (which was little more than a clearing) as a main entrance to the Garden, placing over the gateway the inscription 'The Missouri Botanical Garden' and the date '1858,' showing his vision was keen and broad enough to picture what he believed this child of his brain would ultimately attain.

"During Mr. Shaw's life and for some years after, this gate provided sufficient accommodations to those visiting the Garden. Later with the opening of the Garden on Sundays and other attractive features to the public the attendance increased, and for some time the Board of Trustees have realized that larger and better accommodations at the main entrance were needed. How to provide them was a question. It resulted in what we all at times have had to meet, a financial problem. You are aware that the Garden is supported from the income of the Shaw estate only, about one-fourth of the income being consumed in paying licenses, taxes, etc., to the city and state. In time a plan was evolved whereby with the approval of the circuit court a loan was secured providing

funds, with a provision that a percentage of the annual income be devoted toward liquidating the indebtedness.

"Many of you are familiar with the original gateway, and our architects, Messrs. Jamieson and Spearl, followed the general plan, and the Board wishes to congratulate them upon the success of their efforts, since without unnecessarily destroying the type of entrance as conceived by Mr. Shaw they have increased the needed accommodations some three-fold.

"We meet today to dedicate this structure, and I hope and believe that with the enlarged facilities for the convenience of visitors their numbers may increase, as they can secure a better and more pleasing impression of the Garden than was heretofore possible.

"The Garden has an enviable reputation, both internationally and nationally, standing in the front rank everywhere as an institution of scientific and horticultural attainments.

"The Board of Trustees, as now constituted, is fast approaching and passing the meridian of life (one only of the trustees named in Mr. Shaw's will remaining), and on the trustees who follow us will devolve the duty of carrying out and increasing its reputation and activities.

"We have been fortunate in securing as speaker of the day the Hon. Henry C. Wallace, Secretary of Agriculture, and I take pleasure in introducing him."

At this point in the exercises, owing to the continued downpour of rain, the company adjourned to the floral display house, where the Honorable Henry C. Wallace, Secretary of Agriculture, made the following address:

"It is a privilege to be here today and an honor to be asked to speak briefly on such an occasion. You are in a way dedicating anew to the use of the public these wonderful gardens which for more than half a century have been an inspiration to those who visited them and which have contributed much to our store of knowledge of God's great vegetable kingdom.

"Instinctively our thoughts turn first to that generous-spirited citizen who made all of this possible. I wish I might speak from that intimate personal fellowship which perhaps some of those who are here today enjoyed. But the spirit of a man is made manifest not alone while he is here with us but by the things he does and says which live after he has passed on.

"So thousands who could not know Henry Shaw in the flesh nevertheless have a deep sense of gratitude to him and of kinship with him. Hundreds of thousands of those who neither knew him nor have known of him nevertheless will be

VIEW OF MAIN ENTRANCE FROM INTERIOR OF GARDEN.
(Jamieson and Spearl, architects.)

indebted to him. For the influence of the work that has been done here and, indeed, the influence of these gardens themselves, has spread throughout the nation. The lives of thousands unconsciously have been modified and enlarged and made happier through this influence; and these in turn, knowingly or unknowingly, pass on to others the inspiration received through the opportunity that Henry Shaw made possible to them.

"What sort of man Henry Shaw was and what sort of spirit dominated him are revealed both in his action back in the early sixties, when he invited his fellow citizens to come freely and share with him the beauty and inspiration of these gardens created and maintained at his own expense, and when later he endowed them in his will and made wise provision for their continuance through generations to come. And when we come to read his will, we find the spirit of the man made plain in this sentence:

'I hereby devise and bequeath two hundred dollars annually to the Bishop of the Episcopalian Church of this diocese in consideration (if he approve the same) that an annual sermon be preached in such church and by such minister as he may select, on the wisdom and goodness of God as shown in the growth of flowers, fruits, and other products of the vegetable kingdom.'

"Many men favored of fortune gather to themselves treasures to be hidden away and enjoyed by themselves alone or by some personal friends. There seemed to be none of this selfishness or snobbery in Henry Shaw. He wished to share the things that satisfied his artistic and spiritual nature, not with a chosen few alone, but with all who have within them the capacity to partake with him. And the sentence from his will which I have just read shows very clearly that his motive was not to gather to himself credit for the thing he was doing but to bring to the attention of young and old the goodness of God and the wonders He had wrought.

"He had a keen sense of duty to his fellow man. He came here from a foreign land. In a comparatively short space of time he amassed a fortune. Unlike many who have had a similar life experience, he did not depart with his gain, but devoted his remaining years to good works. He had a high sense of citizenship which ought to be felt by every right-thinking citizen.

"And surely, even in the presence of some of them, I may be permitted to voice the general appreciation of the fine way in which the men chosen have carried out Mr. Shaw's purposes. Too often enterprises of this sort left in trust are carried on in a purely perfunctory way and without that understanding

and heart interest so necessary to the full discharge of the duty imposed. Too often, as the original trustees pass away, interest lags and the purposes of the donor are unfulfilled or thwarted. Not so in this case. On the contrary, those who have been charged with this duty and who have been invited to share a high privilege seem to have entered fully into the desires and ambitions and ideals of Henry Shaw. Men of thought and men of vision have been at work here. There has been a consistent enlargement of the scope of the work carried on, with the thought that these gardens should contribute more and more largely to the educational development in this country and to our scientific knowledge of plant life. The gathering of representative groups of healthy plants, so arranged as to be most attractive and easy to recognize and remember, has added much to the value of these gardens for educational purposes. The technical study of plants, especially in the field of plant physiology, and the opportunity given here for plant students to pursue their investigations have attracted most favorable comment from scientists interested in plant life. As head for the time being of a department which numbers on its staff many of the most eminent scientists of the world, I am glad to acknowledge the value of this work.

"If, however, I should undertake to place relative values upon the various activities which are being carried on here and measure them in percentages set down in orderly fashion, I should place first the subtle influence which these gardens exert upon the lives and characters of those who come for study and research and, more especially, for the pure joy of living for a time among the beautiful plants the good God has given His people.

"Wise parents as they have opportunity bring their children in contact with Nature in her varied forms. They take them to the mountains that they may see Nature in her more rugged aspects, that they may see with their own eyes evidences of the mighty forces which were at work when the land was shaped. They take them to the rivers and to the sea that they may see God's hand upon the waters, now in repose, again lashed into fury by the winds. They take them to the fields and to the forests that they may have some understanding of our dependence upon the soil. They bring them to places such as this, where plants of almost endless variety of form and color, fragrance and beauty, appeal to the finer emotions and thus develop a love of the gentle and beautiful which influences thought and action throughout life and which adds largely to the capacity for happy living.

"Men who have studied such matters tell us that sufficient records have been found to prove the existence of some six or eight great civilizations prior to the one in which we are now living. They tell us further that each of these great civilizations was preceded and followed by periods of darkness; that they went through certain fairly well-revealed stages, the last being the period of wealth. They tell us that as the period of wealth develops there comes the fevered pursuit of artificial pleasures, the rush to the cities, the desertion of the open country, and the consequent breaking down of character and the lapse once more into the period of darkness and despair.

"If this, which we like to think of as the most advanced of all civilizations, is to escape the fate of those that have long since been sifted over by the sands of oblivion, we must profit by the experience of those who have gone before. We must keep our people close to Nature and to Nature's God; for in no other way can we implant in the young those great principles which make for clear thinking and right living, without which an enduring civilization is not possible. In such a task beauty spots like this are invaluable aids.

"Rich is the city which has at its door such a place for inspiration and study freely open to young and old, rich and poor, great and small; freely open to all who will come. And rich is a city and a nation which produces citizens who are willing to give of their time and their money to perpetuate institutions such as this."

At the conclusion of this address, luncheon was served to about three hundred specially invited guests.

Music was furnished, both before the opening of the ceremony at the gate and during the luncheon, by Noel Poepping's orchestra.

HARDY EXOTIC PLANTS SUITABLE FOR THE GARDENS OF MISSOURI AND ADJOINING STATES

(Continued from April Bulletin)

IV. SHRUBS WITH INCONSPICUOUS FLOWERS

Botanical name	Common name	Approx. height	Habitat
Acanthopanax pentaphyllus	Five-leaved aralia	3-6′	Japan
Alnus viridis	Green alder	4-6′	Northern hemisphere
Berberis emarginata	Barberry	2-3′	Europe
Berberis ilicifolia	Holly-leaved barberry	3-5′	South America
Berberis Thunbergii	Thunberg's barberry	3-6′	Japan
Corylus Avellana	European hazel	6-8′	Europe, Asia

Botanical name	Common name	Approx. height	Habitat
Corylus Avellana var. *atropurpurea*	Purple hazel	4-8′	Europe, Asia
Cotoneaster acuminata	Cotoneaster	4-8′	Himalayas
Cotoneaster multiflora	Cotoneaster	4-6′	Europe, Asia
Hippophae rhamnoides	Sea buckthorn	4-8′	Europe, Asia
Rhamnus cathartica	Buckthorn	6-15′	Europe, Asia
Rhamnus dahurica	Chinese buckthorn	6-8′	China
Rhamnus Frangula	Buckthorn	6-15′	Europe, Asia
Salix pentandra	Laurel-leaved willow	8-20′	Europe, Asia
Salix purpurea	Purple willow	6-12′	Europe
Ulmus parvifolia	Chinese elm	10-20′	China, Japan
Ulmus pumila		10-15′	Asia

V. VINES

Botanical name	Common name	Approx. height	Color of flowers	Approx. time of bloom	Habitat
T.* *Actinidia arguta*	Actinidia	10-25′	Greenish white	July	Japan
T. *Akebia lobata*	Akebia	15-30′	Purple	May	China, Japan
T. *Akebia quinata*	Akebia	15-30′	Purple	July	China, Japan
D. *Ampelopsis heterophylla*	Large-leaved ampelopsis	15-20′	Inconspicuous		China
D. *Ampelopsis tricuspidata*	Ampelopsis	30-50′	Inconspicuous		China, Japan
T. *Celastrus orbiculatus*	Japan bittersweet	30-50′	Inconspicuous		China, Japan
LT. *Clematis caerulea*	Clematis	8-10′	Lilac	May	Japan
LT. *Clematis lanuginosa* and varieties	Clematis	5-6′	Lavender or bluish	Summer	China
T. *Clematis paniculata*	Star clematis	20-30′	White	Aug.-Sept.	Japan
LT. *Clematis Vitalba*	Old man's beard	20-30′	White	July-Sept.	Europe, Africa
LT. *Clematis Viticella* and varieties	Clematis	8-12′	Rosy purple	June-Aug.	Europe, Asia
T. *Convolvulus japonicus*	Bindweed	10-20′	White	July-Sept.	Japan, Asia
T. *Dioscorea divaricata*	Chinese yam	10-30′	White	July-Aug.	Philippines

Botanical name	Common name	Approx. height	Habitat
T. *Lonicera japonica*	Japanese honeysuckle.	8-15'..White to yellow..	June-Aug.	China, Japan
T. *Lonicera japonica* var. *Halliana*	Hall's honeysuckle.	8-15'..White to yellow..	Aug.-Sept.	China, Japan
T. *Lonicera Periclymenum*	Woodbine	12-20'..Yellowish white...	June-Sept.	Europe, Africa
T. *Lycium chinense*	Matrimony vine	6-12'..Purple..	May-July	China
T. *Lycium halimifolium*	Matrimony vine	8-12'..Purple..	May-Sept.	China
T. *Periploca graeca*	Silk vine	15-40'..Purplish.	May-June	Europe, Asia
T. *Wisteria chinensis*	Chinese wisteria	20-40'..Purple..	May	China
T. *Wisteria venusta*	Wisteria	20-40'..White...	May	Japan

*T.=twining; LT.=leaf twining; D.=climbing by disks.

VI. TREES WITH CONSPICUOUS FLOWERS

Aesculus Hippocastanum	Horse chestnut	30-40'..White...	May	Himalayas to Greece
Aesculus Hippocastanum var. *flore pleno*	Double-flowered horse chestnut	30-40'..White...	May	Gardens
Aesculus Hippocastanum var. *rubicunda*	Red-flowered horse chestnut	20-30'..Red.....	May	Gardens
Ailanthus glandulosa	Tree of heaven	20-40'..Greenish white...	June	Asia
Aralia chinensis	Chinese angelica tree	20-40'..White...	Aug.-Sept.	China, Japan
Castanea sativa	Chestnut	40-80'..White...	June	Europe, China
Evonymus Bungeana	Spindle-tree	15-30'..Greenish	May-June	China
Evonymus europaeus	European spindle-tree.	10-20'..Yellowish.....	May	Europe, Asia
Exochorda grandiflora	Pearl-bush	8-20'..White...	May-June	China

Botanical name	Common name	Approx. height	Color of flowers	Approx. time of bloom	Habitat
Fraxinus Ornus	Ash	10-25′	Whitish.	May-June	Europe, Asia
Koelreuteria paniculata	Varnish tree.	20-40′	Orange-yellow..	July	Japan
Magnolia Kobus	Magnolia	30-80′	White...	April	Japan
Magnolia Soulangeana	Magnolia	10-30′	Pink....	April	Japan
Magnolia Yulan	Magnolia	30-50′	White...	April	China, Japan
Paulownia imperialis.	Empress tree.	15-30′	Pink....	June	China, Japan
Prunus cerasifera var. *atropurpurea*	Purple-leaved plum	10-20′	Pink....	May	Persia
Prunus incisa	Flowering cherry	10-15′	White...	May	Japan
Prunus Pseudo-Cerasus	Japanese flowering cherry.	20-30′	Pink....	Apr.-May	China, Japan
Prunus Pseudo-Cerasus var. *hortensis*	Double-flowered Japanese cherry.	15-30′	Pink....	Apr.-May	China, Japan
Prunus Pseudo-Cerasus var. *hortensis albo-rosea*	Japanese flowering cherry.	15-30′	Rose to white...	April	Japan
Prunus Pseudo-Cerasus var. *sachalinensis*	Japanese flowering cherry.	25-30′	Pink to rose....	April	Japan
Pyrus baccata	Siberian crab.	15-20′	White...	May	Siberia
Pyrus floribunda	Flowering crab	10-20′	Reddish.	May	Japan
Pyrus Halliana	Hall's crab....	6-15′	Rose....	Apr.-May	Japan
Sophora japonica	Japanese pagoda tree.	40-60′	Yellowish white...	July-Sept.	China
Sophora japonica var. *pendula*	Weeping Japanese pagoda tree.	15-20′	Yellowish white...	July-Sept.	Gardens
Syringa japonica	Japanese lilac.	10-30′	Yellowish white...	June-July	Japan

VII. TREES WITH INCONSPICUOUS FLOWERS

Botanical name	Common name	Approx. height	Habitat
Acer campestre	English cork maple	30-60′	Europe, Asia
Acer ginnala		12′	Turkestan
Acer platanoides	Norway maple	30-80′	Europe, Turkestan
Acer platanoides var. *Schwedleri*	Purple-leáved Norway maple	20-40′	Europe
Acer Pseudoplatanus	Sycamore maple	30-60′	Europe
Acer tataricum	Tartarian maple	15-25′	Europe, Orient
Alnus glutinosa	European alder	15-30′	Europe, Africa, Asia
Alnus glutinosa var. *imperialis*	Cut-leaved alder	20-40′	Europe
Alnus incana	Speckled alder	15-30′	Northern hemisphere
Alnus incana var. *pinnatifida*	Cut-leaved alder	10-20′	Europe
Alnus japonica	Japanese alder	40-80′	Japan
Betula alba	European white birch	20-50′	Europe, Japan
Betula alba var. *pendula laciniata*	Cut-leaved weeping birch	20-40′	Europe
Betula Ermanii	Erman's birch	40-60′	Japan
Broussonetia papyrifera	Paper mulberry	18-30′	China, Japan
Carpinus Betulus	European hornbeam	20-40′	Europe, Persia
Cercidiphyllum japonicum		25-30′	Japan
Fagus sylvatica	European beech	30-50′	Europe
Fagus sylvatica var. *purpurea*	Purple beech	30-50′	Gardens
Fraxinus excelsior	European ash	30-50′	Europe, Asia
Ginkgo biloba	Maidenhair tree	40-80′	China
Juglans Sieboldiana	Japanese walnut	30-50′	Japan
Morus alba	White mulberry	15-40′	China, Asia
Morus alba var. *tatarica pendula*	Tea's weeping mulberry	8-10′	Gardens
Phellodendron amurense	Chinese cork tree	30-50′	China, Japan
Platanus orientalis	Oriental sycamore	60-100′	Europe, Asia
Platanus orientalis var. *acerifolia*	Maple-leaved sycamore	40-80′	Europe
Populus alba	White poplar	40-70′	Europe, Asia
Populus alba var. *Bolleana*	Bolle's poplar	40-70′	Turkestan
Populus alba var. *nivea*	Poplar	40-60′	Gardens
Populus laurifolia	Laurel-leaf poplar	40-80′	Siberia
Populus nigra var. *italica*	Lombardy poplar	30-60′	Europe
Populus Sieboldii	Siebold's poplar	30-40′	Japan
Quercus Cerris	Turkey oak	60-100′	Europe, Asia

Botanical name	Common name	Approx. height	Habitat
Quercus pedunculata	English oak	60-100′	Europe, Asia, Africa
Quercus sessiliflora	Oak	60-100′	Asia, Persia
Salix babylonica	Babylonian weeping willow	30-60′	Caucasus
Salix babylonica var. *dolorosa*	Weeping willow	30-40′	Caucasus
Salix Caprea	Goat willow	19-20′	Europe, Asia
Salix Caprea var. *pendula*	Kilmarnock weeping willow	10-12′	Gardens
Salix elegantissima	Thurlow's willow	8-15′	Japan
Tilia platyphyllos	European linden	20-40′	Europe
Tilia ulmifolia	Linden	30-60′	Europe
Ulmus campestris	English elm	30-50′	Europe
Ulmus montana	Scotch elm	30-60′	Europe, Japan
Zelkova acuminata	Zelkova	25-40′	Japan

INJURY TO PLANTS IN THE GARDEN BY FROST ON MARCH 27

Following an extensive period of unusually warm weather the temperature dropped to 22° F. on the morning of March 27. This low temperature caused the killing of all blossoms of trees and shrubs, most of the leaves, and in some cases the twigs of last year. In a few cases the injury extended into the old wood, and some trees and shrubs were killed back so that they had to be cut to the ground or removed altogether.

TREES

TWIGS AND OLD BRANCHES SEVERELY INJURED

Broussonetia papyrifera (paper mulberry)
Morus alba (white mulberry)
Morus rubra (red mulberry)

TWIGS OF LAST YEAR KILLED

Koelreuteria paniculata (varnish tree)
Phellodendron amurense
Prunus Pissardii (purple-leaf plum)
Salix babylonica (weeping willow)
Salix cinerea (pussy willow)

LEAVES KILLED

Ailanthus glandulosa (tree of heaven)
Crataegus mollis (hawthorn)
Crataegus Oxyacantha (hawthorn)
Evonymus Bungeana
Magnolia Soulangeana
Salix nigra (black willow)

LEAVES SLIGHTLY INJURED

Crataegus songorica (hawthorn)
Evonymus europaea (European strawberry-bush)
Halesia tetraptera (silver-bell)
Ilex opaca (American holly), old leaves dropping, probably caused by frost
Populus deltoides (Cottonwood)
Populus italica (Italian poplar)
Populus tomentosa (poplar)

SHRUBS

All species of Diervilla were killed to the ground, or the wood was so severely injured that the plants had to be cut back to the ground. A few plants protected by buildings escaped serious injury, and a number transplanted some time previous to the date of freezing escaped injury entirely.

TWIGS OF LAST YEAR KILLED

Amorpha fruticosa, plants pruned during the winter escaped injury to wood, while those not pruned were killed back considerably
Aralia spinosa (Hercules' club)
Berberis Thunbergii (Thunberg's barberry)
Caragana arborescens
Corylus Avellana (hazel)
Deutzia gracilis
Deutzia scabra
Forsythia sp.
Kerria japonica
Ligustrum ovalifolium (California privet)
Lonicera fragrantissima (fragrant honeysuckle)
Lonicera Ledebourii (bush honeysuckle)
Lonicera Morrowii (Morrow's bush honeysuckle)
Rhus typhina (staghorn sumac)
Spiraea Bumalda var. "Anthony Waterer"
Spiraea Van Houttei (bridal wreath)
Viburnum tomentosum

FOLIAGE KILLED

Acanthopanax pentaphyllus
Cornus alternifolia (alternate-leaf dogwood)
Cornus Mas (Cornelian cherry)
Magnolia stellata (star magnolia)
Rhodotypos kerrioides (white kerria)
Sambucus sp. (elder)
Spiraea Douglasii
Syringa vulgaris

The injury to herbaceous perennials was not so great. Those in bloom at the time had their blossoms killed, and *Polygonum cuspidatum* froze to the ground.

ROSES

PARTIALLY FROZEN OR SO SEVERELY INJURED AS TO NECESSITATE CUTTING BACK TO GROUND

Rugosa
Conrad F. Meyer
Nova Zembla
All hybrid teas
All hybrid perpetuals

CHECKED BY FROST

Climbers: **Dr. Van Fleet, Silver Moon, Climbing Gruss an Teplitz, Climbing American Beauty**
Orleans and Katherine Zeimet did not show any damage

NOTES.

Doctor B. M. Duggar, Physiologist to the Garden, was elected a member of the American Philosophical Society at their meeting in Philadelphia.

Dr. George T. Moore, Director of the Garden, spoke before the Women's organization of B'nai El congregation, May 5, on "Some Garden Faults and How to Correct Them."

Professor C. G. Woodbury, Chief of the Raw Products Division, National Canners' Association, spent a day in conference at the Garden recently.

Mr. L. P. Jensen, Aboriculturist to the Garden, gave an illustrated lecture before the St. Louis Association of Gardeners, May 4, on "Formal Landscape Gardening," and before the St. Louis Academy of Science, May 16, on "Conservation and Protection of Native Plants."

Mr. H. Morimoto, formerly a successful mushroom grower of California, stopped for a day at the Garden recently on his way to Japan where he hopes to introduce the commercial culture of *Agaricus campestris*.

The April number of Parks and Recreation contains the following articles by Mr. L. P. Jensen: "Publications of Interest to Park Superintendents," "The Conservation of Nature" and "Care in Transplanting Trees and Shrubs."

Mr. G. H. Pring, Horticulturist to the Garden, gave an illustrated lecture before the Mason School Patrons' Association, May 12, on "The International Flower Show of New York."

The Rufus J. Lackland fellowships for the year 1921-22 have been awarded as follows:

Arthur Forrest Camp, A. B. University of California, 1920, M. S. 1921.

Leo Joseph Klotz, B. S. Michigan Agricultural College, 1919, M. S. 1921.

Harry Robert Rosen, B. S. Pennsylvania State College, 1913, M. S. University of Wisconsin, 1915, Associate Professor of Plant Pathology, University of Arkansas, 1918-21.

Ferdinand S. Wolpert, A. B. University of Montana, 1918, reappointed third year.

Other appointments were as follows:

Dr. Joanne L. Karrer, B. S. University of Washington, 1915, M. S. 1916, Ph. D. Washington University, 1920, reappointed Research Assistant to the Missouri Botanical Garden and Teaching Fellow, Henry Shaw School of Botany of Washington University.

Carl George Deuber, B. S. University of Missouri, 1921, Assistant in Zoology, University of Missouri, 1920-21, appointed Teaching Fellow, Henry Shaw School of Botany of Washington University.

STATISTICAL INFORMATION FOR APRIL, 1921

GARDEN ATTENDANCE:

Total number of visitors	16,650

PLANT ACCESSIONS:

Total number of packets of seed received in exchange	921
Total number of plants received in exchange	91
Total number of plants and seeds received as gifts	2,723

PLANT DISTRIBUTION:

Total number of plants and seeds distributed in exchange	83
Total number of plants distributed as gifts	132

LIBRARY ACCESSIONS:

Total number of books and pamphlets bought	31
Total number of books and pamphlets donated	275

HERBARIUM ACCESSIONS:

By Purchase—

Arnold Arboretum—Plants of eastern Asia	337
Bartholomew, E.—"North American Uredinales," Cent. XXIV and XXV, Nos. 2301-2500 inclusive	200
Bush, B. F.—Plants of Missouri	224
Holzinger, John M.—"Musci Acrocarpi Boreali-Americani," Fasc. XVII, Nos. 401-425 inclusive	25

By Gift—

Bisby, G. R. & Buller, A. H. R.—Fungi of Winnipeg, Canada	21
Conard, Prof. H. S.—*Collybia velutipes* Curtis	1
Duggar, Dr. B. M.—*Agaricus* sp. from Los Angeles, California	1
Lloyd, C. G.—Fungi of Texas and of the Philippines	2
Montgomery, Miss Margaret—Plants of Illinois	5

Povah, Prof. A. H. W.—Fungi of New York..... 30
Thaxter, Dr. R.—*Septobasidiums* from Chili..... 3
von Schrenk, Dr. H.—*Aurieularia lenta* on rotten wood from Costa Rica 1
West, Erdman—*Phlebia* from New Jersey..... 1
Zeller, Dr. S. M.—Fungi from Oregon..... 8

By Exchange—

Bureau of Science, Manila, P. I.—Fungi of the Philippine Islands, Borneo, and China..... 713
New York Botanical Garden, by Dr. F. W. Pennell—Scrophulariaceae of the United States..... 47
U. S. National Museum—Miscellaneous herbarium duplicates 210
U. S. National Museum, by Dr. J. N. Rose—Fungi of South America, two photographs of cacti, and cultivated specimen of *Lenophyllum texanum* Rose..... 7

Total.....1836

The Garden is open to the public every day in the year, except New Year's, Fourth of July, Labor Day, and Christmas—week days from 8:00 A. M. until one-half hour after sunset; Sundays from December to April, 1:00 P. M. until sunset, from April to December, 2:00 P. M. until sunset.

The main entrance to the Garden is located at Tower Grove Avenue and Flora Boulevard, on the Vandeventer Avenue car line. Transfer south from all intersecting lines.

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MISSOURI BOTANICAL GARDEN BULLETIN

Vol. IX JUNE, 1921 No. 6

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EXTERIOR VIEW OF PACHYMA COCOS.
(About three-fourths natural size.)

Missouri Botanical Garden Bulletin

Vol. IX St. Louis, Mo., June, 1921 No. 6

INDIAN BREAD OR TUCKAHOE

There was recently sent to the Garden a specimen of the so-called "Tuckahoe" or "Indian Bread," collected by Mr. Z. T. Daniel, near Leslie, Arkansas. In view of the fact that such specimens are not infrequently found, particularly in the southwest, and always arouse considerable curiosity as to their exact nature, it is believed that a popular account of this plant product may be of interest to readers of the BULLETIN.

This tuber-like structure grows underground and is met with only by accident, being frequently thrown up by the plow or uncovered in making ditches or similar excavations. When first taken from the earth it is soft enough to cut with a knife, but soon hardens until it is of an extremely solid and firm consistency. It varies greatly in both size and shape, sometimes being oblong as in the illustration (pl. 20), but it may be globose and as large as a man's head. There is at no time any external indication of the existence of the tuber beneath the ground, although it is reported that hogs are fond of it and apparently are able to detect it from its odor, rooting it up as they do truffles. The formation has always been a puzzle to botanists, even its origin being a matter of conjecture. Although originally it was supposed to be the underground part of some tuber-forming plant like the bindweed, tuckahoe is now universally regarded as being a true fungus to which the name *Pachyma cocos* has been given. In the absence of any fruiting bodies or any indication as to its possible affinities with known forms, the name of course means little or nothing. While tuckahoe is obviously a vegetative mass of fungous threads, which has assumed the resting condition known as a sclerotium, this sclerotial stage is found in a variety of fungous growths and throws no light whatsoever upon the possible systematic position of the plant. Botanically, therefore, these underground fungous masses are of much interest, since they still remain an unsolved problem. Popularly, the chief interest lies in the belief that tuckahoe

formed an important element in the fare of the Indians. Indeed, even yet, in certain parts of the south it is roasted and eaten with salt by the negroes, but whether it ever formed a fundamental part of the food of the Indians would seem to be open to question.

Considerable confusion has existed among both botanists and historians as to just what the Indians meant by tuckahoe. Apparently the name was generic among the eastern Algonqins for round or roundish roots, and was also the name of an Indian loaf of bread, because of its shape. The word is from p'tukweoo, meaning "it is round" or "shaped like a ball." Consequently numerous underground tubers have at one time or another been referred to as tuckahoe, and it seems more than likely that those used exclusively for food were not *Pachyma cocos* but any one of a number of other tubers or roots belonging to the flowering plants. In support of this view, Smith's "History of Virginia," published in 1819, states: "The chief root they have for food is called tockawhoughe. It grows like a flag in marshes. In one day a savage will gather sufficient for a week. These roots are much of the greatness and taste of potatoes." Still earlier, Beverly, in the "History and Present State of Virginia (1722), wrote: "Out of the ground they [the Indians] dig earth nuts, wild onions and a tuberous root they call tuckahoe, which, while crude, is of a very hot and virulent quality. But they can so manage it as in case of necessity to make bread of it. It grows like a flag in the miry marshes, having roots of the magnitude and taste of Irish potatoes." In Campbell's "History of Virginia," published in Philadelphia in 1781, we find: "Of the spontaneous productions of the soil, the principal article of sustenance was the tuckahoe root, of which one man could gather enough in a day to supply him with bread for a week. It was in the summer the principal article of diet among the natives. There is another root found in Virginia called tuckahoe and confounded with the flag-like root described above and erroneously supposed by many to grow without stem or leaf. It appears to be of the Convolvulus species and is entirely unlike the root eaten by the Jamestown settlers." The Swedish botanist, Kalm, a student of Linnaeus, who visited this country about the middle of the eighteenth century and whose travels were published in 1772, throws some light on the true nature of this edible root referred to by the previous historians. He says: "Tawko and Tawking are the Indian names of another plant the root of which they eat. Some of them call it Tuckah. It occurs in moist grounds and

INTERIOR VIEW OF PACHYMA COCOS.
(About three-fourths natural size.)

swamps This is the *Arum virginicum* or 'Virginia wake-robin.'" And again, "Tawkee is another plant, so-called by the Indians who ate it. Some of them called it Tawkin and others Tackoim. This was the *Orontium aquaticum* (Golden Club)." Rafinesque, in his "Medical Flora, published in 1830, states that "all esculent roots were called tuckahoe, such as Apios and potatoes." Numerous other authorities might be cited but it seems clear that the fungus which we now call tuckahoe or Indian bread could not have been one of the chief articles of sustenance for the Indians. As we shall see later, *Pachyma cocos* has little or no nutritive value, and the Indian name tuckahoe, while it may possibly have included fungous masses which are now designated exclusively by this term, originally referred to any edible root.

The first careful chemical examination of the fungus tuckahoe was made by Professor John Torrey in 1819. He concluded that no starch was present but that instead a hitherto undescribed substance, named by him "sclerotin," was found. Five years later Bracconnot published on the jelly-forming constituents of fruits and tubers, grouping them under the general term "pectous substances." In 1827 Torrey republished his original article and stated that the substance he had named sclerotin was identical with the pectic acid of Bracconnot. Various analyses have been made since, and repeated attention has been called to the fact that nothing yet analysed has been reported to contain so large a proportion of pectin-like substance, often running as high as 75 per cent, as *P. cocos*. Unless the nutritive value of pectin bodies is much greater than ordinarily supposed, *Pachyma cocos* could not alone be regarded as sufficient to sustain life, although it might prove a valuable adjunct to other highly nutritious foods.

Various medicinal properties have been ascribed to *Pachyma cocos*, such as an antidote to mineral poisons, poultices on the ulcers that follow yellow fever, cancers, and in Hobbs' "Botanical Handbook" it is listed as an aphrodisiac. It is easy to understand that with the name tuckahoe being applied now only to *Pachyma cocos*, whereas originally it was a representative name for all round or tuberous esculent roots, it should retain the traditional virtues of the large part of the Indian *materia medica*. There seems to be no foundation for the belief that *Pachyma cocos* possesses any practical value, although it will probably continue to be so regarded for an indefinite period. As previously stated, however, it is of the utmost interest from a botanical standpoint, since in spite of

its having been known for more than a century, so little is understood concerning its origin and growth.

One of the first, if not the first, description of the tuckahoe was given by Dr. MacBride of South Carolina He discussed the specimen under the name *Lycoperdon solidum*, which had been given to it by Clayton in 1762, under the impression that it was related to the common puff-ball. MacBride states that the growth originates between the wood and bark of living roots; that it gradually detaches the bark while it spreads around the wood and converts it into a substance similar to itself. Various other observers have noted the association of *Pachyma* with the roots of trees. One writer states that "in almost every case I have observed that they have been plainly attached to a root of another growth. This root is usually about ½" to ¾" in diameter, outside the tuber frequently larger; sometimes runs directly through the center of it, sometimes nearer one side than the other. This root is always free from bark inside the tuber and is often diminished to a slender stalk or single fiber and is sometimes imperceptible, having the appearance of being eaten away more or less or entirely in the process of formation." In a description of the discovery of several masses of Pachyma from Georgia it is stated that "this growth had taken place from the roots of pines as was evident from some having just commenced growing, the pine root extending through and reaching out at each side. Others were developed to considerable size, showing no appearance of any root in them, or any bark of the pine on the outside as was the case with the smaller ones. I think the whole root for 2" or more is changed into this substance, from the fact that some of the roots extend entirely through it, some of them being smaller inside and larger outside." Indeed, early investigators held that the Pachyma was in the main only an altered state of the root of a tree, the alteration being due to the presence of some fungous disease. While there can be no question that Pachyma is frequently associated with the roots of trees, there is no evidence to indicate that this is invariably the case or that the fungus is in any sense parasitic upon the roots of higher plants. The association would seem to be purely accidental and is of course the thing to be expected from an underground growth of this character.

In general, it may be stated that the structure of the fungus is similar to that of other sclerotia, being made up of a compact mass of threads, having a rough, dark-colored exterior more or less resembling the bark of some trees. No spores or reproductive bodies of any sort have ever been dis-

covered, and, so far as known, the only method of multiplication is from the vegetative mass itself.

Pachyma cocos has been found as far north as New York and Pennsylvania and is reported from Virginia, North and South Carolina, Tennessee, Georgia, Mississippi, Kansas, Arkansas, Texas, and Florida. Apparently, while there is no definite limit to its occurrence in the south, it does not occur where the ground is subjected to prolonged freezing. Ordinarily the character of the soil has something to do with its growth, since it is almost invariably found in a light loam or sandy soil where there is not excessive moisture. Similar underground growths comparable to the American tuckahoe have been found in other parts of the world. Indeed, it is probable that the Fuh-Ling of the Chinese *materia medica* is the same as *Pachyma cocos*. There are likewise other underground fungous growths which seem to differ considerably from the true Pachyma but in the absence of reproductive bodies it is impossible to state whether there is any real affinity or not.

HARDY EXOTIC PLANTS SUITABLE FOR THE GARDENS OF MISSOURI AND ADJOINING STATES

(Continued from May Bulletin)

VIII. EVERGREEN TREES AND SHRUBS. CANNOT BE GROWN IN SMOKY ATMOSPHERE OF CITIES

Botanical name	Common name	Approx. height	Habitat
	SHRUBS		
Juniperus communis	Common juniper	4-6′	England
Juniperus communis var. *hibernica*	Irish juniper	4-6′	England
Picea excelsa var. *pumila*	Dwarf Norway spruce.	2-6′	Gardens
Taxus baccata	English yew	4-10′	Europe to Himalayas
Taxus cuspidata	Japanese yew	8-12′	Japan
	TREES		
Abies Nordmanniana	Nordman's fir	75-140′	Caucasus
Abies Picea	Silver fir	100-150′	Southern Europe
Abies Veitchii	Silver fir	80-100′	Japan and Manchuria
Picea bicolor	Japanese spruce	80-150′	Japan
Picea excelsa	Norway spruce	30-60′	Europe
Picea Omorika	Spruce	80-100′	Europe

Botanical name	Common name	Approx. height	Habitat
Picea orientalis	Oriental spruce	80-120′	Asia and Caucasus
Pinus Cembra	Swiss stone pine	70-100′	Alps to northern Asia
Pinus densiflora	Japanese red pine	80-100′	Japan
Pinus Laricio var. *austriaca*	Austrian pine	30-50′	Austria
Pinus montana	Swiss mountain pine	10-20′	Middle Europe
Pinus sylvestris	Scotch pine	70-100′	Europe to Asia
Thuja orientalis	Chinese arbor-vitae	10-20′	China

IX. GROUND-COVER PLANTS

Botanical name	Common name	Approx. height	Color of flowers	Approx. time of bloom	Habitat
Achillea Ptarmica	Yarrow	6-18″	White	Summer	N. temp. regions
Achillea Tournefortii	Yarrow	1-1½′	Pale yellow	Summer	Greece
Ajuga reptans var. *rubra*	Ajuga	Trailing	Blue	June-July	Gardens
Asperula odorata	Sweet woodruff	Trailing	White	May-June	Europe to Orient
Cerastium Biebersteinii	Cerastium	Trailing	White	June-July	Asia
Cerastium tomentosum	Cerastium	Trailing	White	June-July	Europe
Coronilla varia	Crown vetch	1-2′	White or pink	June-Oct.	Europe
Dianthus plumarius	Garden pink	6-12″	Various colors	Summer	Europe, Siberia
Geum reptans	Geum	Trailing	Yellow	May-June	Europe
Hieracium praealtum	Hieracium	2-3′	Yellow	June-Sept.	Europe
Linaria vulgaris	Butter-and-eggs	1-2′	Yellow	May-June	Europe
Lysimachia clethroides	Lysimachia	1-3′	White	July-Sept.	Japan
Lysimachia Nummularia	Moneywort	Trailing	Yellow	June-Aug.	Europe
Malva rotundifolia	Trailing mallow	Trailing	Whitish	Summer	Europe
Mentha spicata	Spearmint	1-2′	White	Summer	Europe
Nepeta Glechoma	Gill-over-the-ground	Trailing	Blue	Summer	Europe Asia

Botanical name	Common name	Approx. height	Color of flowers	Approx. time of bloom	Habitat
Nierembergia rivularis	White cup	3-4'	White	July-Sept.	South America
Omphalodes verna	Creeping forget-me-not	Trailing	White	April-May.	Europe
Potentilla verna	Trailing cinquefoil	Trailing	Yellow	April-May.	Europe,
Ranunculus repens and var. *flore-pleno*	Creeping buttercup	Trailing	Yellow	May-July.	N. Hemisphere
Saponaria officinalis	Bouncing Bet	1-2'	Light pink	Summer	Europe
Veronica circaeoides	Speedwell	3-6'	Blue	May-June.	Middle Europe
Veronica repens	Creeping speedwell	Trailing	Blue	May	Corsica
Vinca minor	Periwinkle	Trailing	Blue	April-May.	Europe

RECORD OF SHORT HARDWOOD CUTTINGS

To determine what success might be obtained from short hardwood cuttings, cuttings were taken from a number of trees and shrubs directly from the plant in a dormant condition and placed in an ordinary sand cutting-bed in a house where the temperature was held as near as possible to a minimum of 35° and a maximum of about 50°F. The cuttings were made from four to six inches long. The following table shows the results obtained.

Scientific name	Common name	Date of placing cuttings in sand	Date of showing leaf growth	Date when fully rooted	Percentage rooted
Acanthopanax pentaphyllus	Five-leaved aralia	Dec. 20	Jan. 13	Feb. 7	77
Acer Negundo	Box elder	Dec. 22	Jan. 19	Mar. 28	9
Acer tataricum var. *aidzuensis*	Tartarian maple	Dec. 3	Jan. 26		0
Aesculus flava	Buckeye	Dec. 15	Feb. 4		0
Aesculus parviflora	Buckeye	Dec. 11	Jan. 13		0
Alnus campestris	European alder	Dec. 17	Jan. 29		0
Alnus incana	Alder	Dec. 15	Feb. 15	Apr. 5	20
Amorpha fruticosa	False indigo	Dec. 12	Jan. 26	Feb. 19	40
Ampelopsis aconitifolia	Ampelopsis	Jan. 3	Jan. 19	Feb. 18	100

Scientific name	Common name	Date of placing cuttings in sand	Date of showing leaf growth	Date when fully rooted	Percentage rooted
Ampelopsis Engelmannii	Woodbine	Jan. 3	Mar. 1	Mar. 28	85
Ampelopsis tricolor.	Ampelopsis	Jan. 3	Jan. 24	Mar. 28	100
Ampelopsis vitacea var. *dubia*	Ampelopsis	Jan. 3	Feb. 8	Mar. 28	100
Aralia spinosa	Hercules' club	Dec. 11	Jan. 12		0
Baccharis halimifolia	Groundsel bush	Dec. 3	Dec. 16		0
Benzoin aestivale	Spice bush	Jan. 4	Jan. 28		0
Berberis canadensis.	Barberry	Jan. 4	Jan. 18		0
Broussonetia papyrifera	Paper mulberry	Dec. 17	Jan. 10	Feb. 17	56
Buddleia japonica	Buddleia	Jan. 31	Feb. 8	Mar. 11	85
Calycanthus floridus	Carolina allspice.	Dec. 15	Feb. 11		0
Caragana arborescens	Pea shrub	Dec. 15	Dec. 24	Jan. 19	90
Caragana arborescens var. *pendula*	Weeping pea shrub	Dec. 24	Jan. 6	Feb. 9	60
Carya cordiformis	Swamp hickory	Jan. 2	Jan. 31		0
Catalpa Bungei	Japanese catalpa.	Dec. 20	Jan. 13	Mar. 28	8
Celastrus paniculatus	Bittersweet	Jan. 4	Feb. 6	Mar. 28	40
Cephalanthus occidentalis	Button-bush	Jan. 20	Feb. 14	Mar. 14	95
Cercis canadensis var. *alba*	White-flowered redbud	Dec. 6	Jan. 18		0
Cercis chinensis	Chinese redbud	Dec. 22	Feb. 14		0
Chionanthus virginica	White fringe	Feb. 6	Mar. 7		0
Cornus Amomum	Silky cornel	Dec. 18	Jan. 18	Mar. 28	5
Cornus asperifolia	Cornel	Jan. 11	Feb. 11		0
Cornus Baileyi	Bailey's cornel	Dec. 14	Jan. 1	Mar. 1	50
Cornus circinata	Round-leaved cornel	Dec. 16	Jan. 16	Feb. 15	55
Cornus florida	Flowering dogwood	Dec. 17	Jan. 28		0
Cornus glabrata	Cornel	Dec. 20	Jan. 24	Mar. 28	30
Cornus mas	Cornelian cherry.	Dec. 17	Jan. 18	Feb. 26	65
Cornus paniculata	Panicled dogwood	Dec. 16	Jan. 24		0
Cornus sibirica	Red-branched dogwood	Jan. 3	Jan. 24		77
Cornus stolonifera	Red-branched dogwood	Dec. 20	Jan. 24	Mar. 28	50
Cornus stolonifera var. *flaviramea*	Yellow-branched dogwood	Dec. 9	Jan. 24	Feb. 15	45

Scientific name	Common name	Date of placing cuttings in sand	Date of showing leaf growth	Date when fully rooted	Percentage rooted
Corylus Avellana var. *atropurpurea*	Purple hazel	Jan. 16	Feb. 16		0
Crataegus Oxyacantha	Hawthorn	Dec. 13	Jan. 13		0
Cydonia japonica	Japanese quince	Dec. 20	Dec. 31	Mar. 28	7
Cyrilla racemiflora	Cyrilla	Dec. 3	Feb. 11		0
Cytisus scoparius	Scotch broom	Dec. 22	Jan. 5	Mar. 1	50
Deutzia gracilis	Deutzia	Dec. 14	Jan. 2	Feb. 28	45
Deutzia scabra	Deutzia	Dec. 9	Dec. 20	Jan. 21	70
Diervilla "Abel Carriere"	Weigelia	Dec. 10	Jan. 2		0
Diervilla amabilis	Weigelia	Dec. 10	Jan. 2	Mar. 14	2
Diervilla "Eva Rathke"	Weigelia	Dec. 10	Jan. 2	Mar. 23	4
Diervilla floribunda	Weigelia	Dec. 10	Jan. 2	Mar. 14	16
Diervilla "Gustave Mallet"	Weigelia	Dec. 9	Jan. 2	Mar. 14	20
Diervilla lutea	Weigelia	Dec. 22	Jan. 19		0
Diervilla "Madame Couturier"	Weigelia	Dec. 10	Jan. 5	Mar. 14	6
Diervilla rosea	Weigelia	Dec. 10	Jan. 10	Mar. 14	7
Diervilla trifida	Weigelia	Dec. 10	Jan. 18		0
Diervilla Van Houttei	Weigelia	Dec. 9	Jan. 2	Mar. 14	50
Diospyros virginiana	Persimmon	Jan. 8	Feb. 8		0
Elaeagnus longipes	Japanese oleaster	Dec. 22	Jan. 18		0
Elaeagnus umbellata	Oleaster	Dec. 23	Jan. 13	Apr. 5	2
Evonymus alata	Spindle tree	Jan. 4	Jan. 19		0
Evonymus atropurpurea	Burning-bush	Dec. 4	Feb. 16		0
Evonymus Bungeana	Spindle tree	Dec. 9	Dec. 21	Mar. 28	13
Evonymus europaea	Spindle tree	Dec. 13	Dec. 24	Mar. 28	3
Evonymus usuriensis	Spindle tree	Dec. 4	Jan. 24		0
Forsythia intermedia	Golden-bell	Dec. 6	Jan. 2	Mar. 14	45
Forsythia suspensa	Golden-bell	Dec. 9	Jan. 2	Feb. 28	24
Forsythia viridissima	Golden-bell	Dec. 9	Dec. 20	Mar. 14	62
Fraxinus pistaciaefolia	Ash	Dec. 18	Jan. 19	Apr. 5	30
Ginkgo biloba	Maidenhair tree	Dec. 20	Feb. 4	Apr. 5	10
Grewia parviflora	Grewia	Jan. 31	Feb. 15		0
Halesia tetraptera	Silver bell	Dec. 4	Jan. 19	Apr. 4	15
Hamamelis virginiana	Witch hazel	Dec. 4	Mar. 7		0
Hibiscus syriacus var. *amplissimus*	Rose of Sharon	Jan. 5	Jan. 26	Apr. 4	6
Hibiscus syriacus var. *anemonae florus*	Rose of Sharon	Jan. 5	Jan. 26		0

Scientific name	Common name	Date of placing cuttings in sand	Date of showing leaf growth	Date when fully rooted	Percentage rooted
Hibiscus syriacus var. *ardens*	Rose of Sharon	Jan. 5	Jan. 28	Apr. 5	3
Hibiscus syriacus var. "Boule de Feu"	Rose of Sharon	Jan. 5	Jan. 28	Apr. 5	7
Hibiscus syriacus var. *carneus*	Rose of Sharon	Jan. 5	Jan. 26		0
Hibiscus syriacus var. *coelestis*	Rose of Sharon	Jan. 4	Jan. 25		0
Hibiscus syriacus var. "Duchesse de Brabant"	Rose of Sharon	Jan. 5	Jan. 26		0
Hibiscus syriacus var. "Lady Stanley"	Rose of Sharon	Jan. 5	Jan. 26	Apr. 11	40
Hibiscus syriacus var. *purpureus*	Rose of Sharon	Jan. 5	Jan. 26		0
Hibiscus syriacus var. *pulcherrimus*	Rose of Sharon	Jan. 5	Jan. 24	Apr. 1	45
Hibiscus syriacus var. *puncens plena*	Rose of Sharon	Jan. 5	Jan. 28		0
Hibiscus syriacus var. *rubra plena*	Rose of Sharon	Jan. 5	Jan. 26	Apr. 5	3
Hibiscus syriacus single white, tinged red	Rose of Sharon	Dec. 13	Jan. 10	Apr. 5	1
Hippophae rhamnoides	Sea buckthorn	Dec. 13	Dec. 24	Mar. 10	48
Hydrangea arborescens var. *grandiflora*	Hydrangea	Dec. 6	Feb. 4	Apr. 5	13
Hydrangea paniculata	Hydrangea	Dec. 9	Feb. 11		0
Hydrangea paniculata var. *grandiflora*	Hydrangea	Dec. 4	Feb. 5		0
Hydrangea quercifolia	Oak-leaved hydrangea	Jan. 4	Feb. 5		0
Ilex opaca	American holly	Dec. 23	Jan. 15		0
Juglans rupestris	Walnut	Dec. 22	Jan. 28		0
Juglans Sieboldiana	Japanese walnut	Dec. 24	Feb. 2		0
Kerria japonica var. *plena*	Kerria	Dec. 9	Dec. 22		0
Koelreuteria paniculata	Varnish tree	Dec. 24	Jan. 19		0
Leitneria floridana	Leitneria	Dec. 3	Jan. 18		0
Ligustrum amurense	Privet	Jan. 31	Feb. 11	Mar. 25	85
Ligustrum Ibota	Privet	Dec. 15	Dec. 31	Mar. 28	12
Ligustrum Ibota var. *Regelianum*	Regel's privet	Dec. 16	Jan. 2	Mar. 15	50

Scientific name	Common name	Date of placing cuttings in sand	Date of showing leaf growth	Date when fully rooted	Percentage rooted
Ligustrum ovalifolium	California privet	Dec. 23	Jan. 17	Feb. 17	40
Ligustrum Stauntonii	Staunton's privet	Dec. 18	Jan. 10	Mar. 28	85
Ligustrum vulgare	English privet	Dec. 15	Jan. 2	Feb. 4	40
Liquidambar Styraciflua	Sweet gum	Jan. 3	Feb. 14		0
Liriodendron tulipifera	Tulip tree	Jan. 3	Feb. 14		0
Lonicera fragrantissima	Fragrant honeysuckle	Dec. 3	Dec. 15	Jan. 3	90
Lonicera gigantea	Giant honeysuckle	Jan. 4	Jan. 13		0
Lonicera Ledebourii	Bush honeysuckle	Dec. 13	Dec. 23	Feb. 17	50
Lonicera micrantha	Bush honeysuckle	Dec. 15	Jan. 18	Jan. 21	90
Lonicera Morrowii	Morrow's bush honeysuckle	Dec. 9	Dec. 20	Jan. 18	90
Lonicera Standishii	Bush honeysuckle	Jan. 31	Feb. 15	Mar. 28	95
Lonicera tatarica	Tartarian honeysuckle	Dec. 6	Jan. 2	Jan. 6	65
Magnolia acuminata	Cucumber tree	Dec. 24	Feb. 9		0
Magnolia Fraseri	Fraser's magnolia	Dec. 3	Jan. 19		0
Magnolia glauca	Swamp bay	Jan. 3	Feb. 1		0
Magnolia obovata	Magnolia	Jan. 3	Jan. 26		0
Magnolia Soulangeana	Magnolia	Dec. 24	Jan. 24		0
Magnolia stellata	Star magnolia	Dec. 24	Feb. 8		0
Neviusia alabamensis	Snow wreath	Dec. 3	Dec. 15	Feb. 14	45
Nyssa sylvatica	Sour gum	Dec. 21	Feb. 12		0
Phellodendron amurense	Japanese cork tree	Jan. 31	Feb. 15		0
Philadelphus californicus	Mock orange	Dec. 15	Jan. 18	Jan. 25	100
Philadelphus columbianus	Mock orange	Dec. 15	Jan. 2		0
Philadelphus coronarius	Mock orange	Dec. 15	Jan. 18	Jan. 25	100
Philadelphus Coulteri	Mock orange	Dec. 14	Jan. 5	Feb. 25	22
Philadelphus erectus	Mock orange	Dec. 14	Jan. 5	Mar. 1	3

Scientific name	Common name	Date of placing cuttings in sand	Date of showing leaf growth	Date when fully rooted	Percentage rooted
Philadelphus Falconeri	Mock orange	Dec. 14	Jan. 2	Mar. 1	98
Philadelphus Gordonianus	Mock orange	Dec. 10	Jan. 28	Mar. 10	95
Philadelphus grandiflorus	Mock orange	Dec. 10	Jan. 10	Feb. 9	45
Philadelphus inodorus	Mock orange	Dec. 10	Jan. 10	Feb. 9	88
Philadelphus latifolius	Mock orange	Dec. 15	Jan. 2	Jan. 25	100
Philadelphus laxus	Mock orange	Dec. 14	Jan. 5	Feb. 10	75
Philadelphus Lewisii	Mock orange	Dec. 10	Jan. 2	Feb. 9	65
Philadelphus Magdalenae	Mock orange	Dec. 15	Jan. 5	Mar. 1	20
Philadelphus maxima	Mock orange	Dec. 15	Jan. 19	Feb. 3	75
Philadelphus nepalensis	Mock orange	Dec. 15	Dec. 31	Jan. 29	60
Philadelphus nivalis	Mock orange	Dec. 15	Jan. 5	Jan. 29	65
Philadelphus pubescens	Mock orange	Dec. 14	Jan. 19	Feb. 25	65
Philadelphus Rosace	Mock orange	Dec. 14	Jan. 19	Mar. 14	65
Philadelphus sericanthus var. *Rehderianus*	Mock orange	Dec. 14	Jan. 5	Mar. 1	14
Philadelphus splendens	Mock orange	Dec. 14	Jan. 19	Feb. 11	72
Philadelphus virginale	Mock orange	Dec. 14	Jan. 19	Feb. 10	43
Physocarpus opulifolius	Ninebark	Dec. 11	Jan. 1	Feb. 4	20
Physocarpus Ramaleyi	Ninebark	Dec. 24	Jan. 17	Feb. 26	95
Pistacia chinensis	Pistachio	Dec. 24	Dec. 28	Jan. 25	20
Platanus acerifolia	Maple-leaved sycamore	Dec. 20	Feb. 15	Feb. 17	85
Platanus orientalis	Oriental sycamore	Dec. 20	Feb. 11	Feb. 16	98
Populus acuminata	Poplar	Dec. 20	Feb. 9	Mar. 7	98
Populus balsamifera	Balsam poplar	Dec. 20	Feb. 14	Apr. 5	60
Populus tomentosa	Poplar	Dec. 20	Jan. 31	Feb. 7	14
Prunus avium	Flowering cherry	Dec. 15	Jan. 18		0
Prunus communis	Peach	Dec. 21	Jan. 18		0

Scientific name	Common name	Date of placing cuttings in sand	Date of showing leaf growth	Date when fully rooted	Percentage rooted
Prunus pennsylvanica	Wild red cherry	Dec. 4	Feb. 11		0
Prunus persica var. *Nectarina*	Nectarine	Dec. 30	Feb. 8		0
Prunus prostrata	Trailing cherry	Dec. 24	Jan. 13		0
Prunus tomentosa	Japanese cherry	Dec. 21	Jan. 17	Feb. 26	36
Prunus triflora	Japanese plum	Dec. 24	Jan. 29	Mar. 28	10
Prunus triloba	Flowering plum	Dec. 22	Jan. 24	Feb. 26	65
Prunus virginiana, var. *leucocarpa*	Wild black plum	Dec. 22	Feb. 22		0
Ptelea trifoliata	Hop tree	Dec. 15	Jan. 31		0
Pyrus arbutifolia	Red chokeberry	Dec. 15	Dec. 31		0
Pyrus Arnoldiana	Flowering crab	Dec. 24	Jan. 13		0
Pyrus Bretschneideri	Flowering crab	Dec. 24	Jan. 29		0
Pyrus Michauxii	Flowering crab	Dec. 24	Feb. 4		0
Pyrus Sargentii	Sargent's crab	Dec. 22			0
Pyrus serotina	Flowering crab	Dec. 31	Jan. 24		0
Pyrus sphaerocarpa var. *globosa*	Flowering crab	Dec. 31	Jan. 24		0
Pyrus transitoria	Flowering crab	Jan. 4	Jan. 19		0
Pyrus yunnanensis	Flowering crab	Dec. 21	Feb. 9		0
Quercus imbricaria	Shingle oak	Dec. 22	Feb. 17		0
Quercus rubra	Red oak	Dec. 22	Feb. 14		0
Rhamnus Frangula	Buckthorn	Dec. 16	Jan. 19	Mar. 28	3
Rhamnus japonica	Japanese buckthorn	Dec. 13	Jan. 10		0
Rhamnus Purshiana	Buckthorn	Dec. 4	Feb. 14		0
Rhamnus saxatilis	Buckthorn	Jan. 4	Jan. 25		0
Rhododendron sinense	Azalea	Jan. 4	Jan. 20		0
Rhodotypos kerrioides	White kerria	Dec. 13	Jan. 2		0
Rhus canadensis	Fragrant sumac	Dec. 15	Jan. 24	Mar. 28	22
Rhus copallina	Smooth sumac	Dec. 14	Jan. 20		0
Ribes aureum	Missouri currant	Dec. 13	Dec. 31	Feb. 9	25
Ribes Schneideri	Flowering currant	Dec. 24	Jan. 13	Feb. 8	45
Ribes tenuiflorum	Flowering currant	Dec. 24	Jan. 24		0
Robinia Decaisneana	Locust	Jan. 31	Feb. 22		0
Robinia hispida	Rose acacia	Dec. 15	Jan. 17		0
Robinia Kelseyi	Kelsey's rose acacia	Dec. 23	Jan. 28		0
Salix adenophylla	Willow	Dec. 18	Jan. 19	Jan. 29	75
Salix cinerea	Willow	Dec. 10	Dec. 24	Jan. 7	100
Salix tristis	Dwarf gray willow	Dec. 22	Jan. 5	Jan. 10	40
Salix viminalis	Willow	Dec. 24	Jan. 20	Jan. 31	98

Scientific name	Common name	Date of placing cuttings in sand	Date of showing leaf growth	Date when fully rooted	Percentage rooted
Sambucus nigra	Elder	Dec. 13	Jan. 10	Jan. 7	100
Sassafras variifolium	Sassafras	Dec. 15	Jan. 29		0
Securinega ramiflora	Securinega	Dec. 18	Jan. 13	Feb. 17	60
Sorbaria arborea	Mountain ash	Dec. 15	Jan. 2	Feb. 16	3
Spiraea Billiardi	Spiraea	Dec. 9	Jan. 10	Jan. 24	90
Spiraea bracteata	Spiraea	Dec. 4	Jan. 2	Feb. 22	50
Spiraea Bumalda var. "Anthony Waterer"	Spiraea	Dec. 11	Jan. 2	Mar. 28	48
Spiraea cantoniensis	Spiraea	Jan. 4	Jan. 13	Apr. 5	7
Spiraea Douglasii	Douglas's spiraea	Dec. 15	Jan. 5	Jan. 18	100
Spiraea Menziesii	Spiraea	Dec. 3	Jan. 5	Jan. 18	100
Spiraea prunifolia	Spiraea	Dec. 17	Jan. 10		100
Spiraea Reevesiana	Bridal-wreath	Jan. 4	Jan. 13	Apr. 5	10
Spiraea salicifolia	Willow-leaved spiraea	Dec. 10	Jan. 9	Feb. 9	97
Spiraea Van Houttei	Bridal-wreath	Dec. 9	Jan. 2	Feb. 8	9
Staphylea pinnata	Hop tree	Dec. 24	Jan. 20	Apr. 5	48
Staphylea trifolia	Hop tree	Dec. 4	Jan. 24	Apr. 5	12
Symphoricarpos racemosus	Snowberry	Dec. 17	Feb. 8	Feb. 11	84
Symphoricarpos vulgaris	Indian currant	Dec. 16	Jan. 20	Jan. 26	64
Syringa villosa var. *Oemodi*	Chinese lilac	Dec. 17	Jan. 5	Feb. 8	40
Syringa vulgaris var. *nigricans*	Lilac	Dec. 18	Jan. 5	Feb. 23	30
Tamarix gallica	Tamarix	Dec. 17	Jan. 10	Feb. 10	55
Tilia platyphyllos	European linden	Dec. 17	Jan. 20		0
Ulmus campestris	English elm	Dec. 17	Jan. 31		0
Ulmus incana	Elm	Dec. 15	Jan. 31		0
Ulmus montana	Scotch elm	Jan. 18	Feb. 17		0
Viburnum Carlesii	Viburnum	Jan. 3	Jan. 26		0
Viburnum cassinoides	Withe-rod	Dec. 13			0
Viburnum dentatum	Arrow-wood	Dec. 11	Feb. 7	Feb. 23	25
Viburnum Lantana	Wayfaring tree	Dec. 12	Dec. 26		0
Viburnum Lentago	Sheep-berry	Dec. 10	Feb. 11		0
Viburnum molle	Viburnum	Dec. 11	Feb. 23		12
Viburnum nudum	Viburnum	Dec. 20	Feb. 15		0
Viburnum Opulus	High-bush cranberry	Dec. 10	Feb. 11	Feb. 16	26
Viburnum prunifolium	Black haw	Dec. 18	Feb. 16		0
Viburnum rufidulum	Viburnum	Dec. 22	Feb. 12		0

Scientific name	Common name	Date of placing cuttings in sand	Date of showing leaf growth	Date when fully rooted	Percentage rooted
Viburnum Sargentii	Sargent's viburnum	Dec. 14	Jan. 29		80
Viburnum theiferum	Viburnum	Dec. 22	Jan. 13	Feb. 8	50
Viburnum tomentosum	Japanese snowball	Dec. 13	Jan. 2	Feb. 8	32

NOTES.

Dr. Hermann von Schrenk, Pathologist to the Garden, has recently been elected vice-president of the American Forestry Association.

Mr. A. B. Seymour, of the Cryptogamic Herbarium, Harvard University, spent a day at the Garden, June 23, consulting the library.

Dr. B. M. Duggar, Physiologist to the Garden, is spending the summer in scientific work at the Coastal Laboratory of the Carnegie Institution of Washington, Carmel, California.

At the commencement of Washington University, June 9, the degree of Doctor of Philosophy was conferred upon the following members of the graduate laboratory of the Missouri Botanical Garden: George Miller Armstrong, Edwin Blake Payson, and Robert William Webb.

Recent visitors to the Garden include Dr. Mitsunaga Fujioka, Assistant Professor of Forestry, Kyushu Imperial University, Fukuoka, Japan; Dr. Charles Thom, of the United States Bureau of Chemistry; and Dr. William Crocker and Mr. John M. Arthur, of the Thompson Institute for Plant Research, Yonkers, New York.

STATISTICAL INFORMATION FOR MAY, 1921

GARDEN ATTENDANCE:

Total number of visitors..... 31,436

PLANT ACCESSIONS:

Total number of plants and seeds received as gifts.... 153

LIBRARY ACCESSIONS:

Total number of books and pamphlets bought..... 13
Total number of books and pamphlets donated..... 430

HERBARIUM ACCESSIONS:

By Purchase—

Davis, Rev. John—Plants of Missouri, North and South Carolina, etc.	314

By Gift—

Buchholz, Professor John T.—*Trillium* sp. from Arkansas	1
Davidson, Dr. Anstruther—*Ceanothus* from California.	2
Duggar, Dr. B. M.—*Hebeloma hortense* Burt.	1
Hills, Mrs. Wm. A.—*Ellisia Nyctelea* L. from Illinois.	1
Ledman, O. S.—*Ledum palustre* L. from Germany.	1
Lloyd, C. G.—Fungi of Washington.	2
McWhorter, F. P—*Daedalea unicolor* from Tennessee.	1
Moxley, George L.—Plants of California.	6
Payson, E. B.—Plants of Wyoming, Colorado and Idaho	55
Rosen, H. R.—*Septoria nodorum*, glume blight of wheat	1
Whelpley, Dr. H. M.—*Polygala Senega* L.	1

By Exchange—

Bureau of Science, Manila, by Dr. H. A. Lee—*Basidiomycetes* of the Philippines	119
Bureau of Science, Manila, by E. D. Merrill—Mosses of the Philippine Islands, China and Sumatra.	60
Gray Herbarium, Harvard University, by Professor M. L. Fernald—Type material of *Lophiola septentrionalis* Fernald	2
Gray Herbarium, Harvard University, by Professor B. L. Robinson—Fragments of the type of *Senecio subsquarrosus* Greenm.	1
Tonduz, Ad.—Plants of Guatemala.	201
U. S. National Museum—*Senecio domingensis* Urban from Haiti	1
Total.	770

The Garden is open to the public every day in the year, except New Year's, Fourth of July, Labor Day, and Christmas—week days from 8:00 A. M. until one-half hour after sunset; Sundays from December to April, 1:00 P. M. until sunset, from April to December, 2:00 P. M. until sunset.

The main entrance to the Garden is located at Tower Grove Avenue and Flora Boulevard, on the Vandeventer Avenue car line. Transfer south from all intersecting lines.

STAFF
OF THE MISSOURI BOTANICAL GARDEN

Director,
GEORGE T. MOORE.

BENJAMIN MINGE DUGGAR,
Physiologist in charge of Graduate Laboratory.

EDWARD A. BURT,
Mycologist and Librarian.

HERMANN VON SCHRENK,
Pathologist.

JOANNE L. KARRER,
Research Assistant.

JESSE M. GREENMAN,
Curator of Herbarium.

KATHERINE H. LEIGH,
Secretary to the Director.

NELL C. HORNER,
Editor of Publications.

G. H. PRING,
Horticulturist.

JOHN NOYES,
Landscape Designer.

L. P. JENSEN,
Arboriculturist.

PAUL A. KOHL,
Floriculturist.

P. C. BRAWNER,
Painter.

W. F. LANGAN,
Engineer.

H. VALLENTINE,
Construction.

MISSOURI BOTANICAL GARDEN BULLETIN

Vol. IX SEPTEMBER, 1921 No. 7

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SEED FROM WHICH CHAULMUGRA OIL IS OBTAINED. PLANTS NOW ESTABLISHED AT THE GARDEN.

Missouri Botanical Garden Bulletin

Vol. IX St. Louis, Mo., September, 1921 No. 7

CHAULMUGRA OIL
A REPORTED SPECIFIC FOR LEPROSY

In spite of the fact that chairs of materia medica no longer exist in many of the leading medical colleges, it is still necessary occasionally to turn to plants to find a cure which cannot be obtained elsewhere. Even though the essential principle of the remedy ultimately be made synthetically, its original application was learned through the beneficial use of some plant, and it is interesting to note that the few real specifics in medicine have all had their origin in plant products. From some results recently obtained it would appear that in the expressed oil from the seed of *Hydnocarpus Kurzii* (King) Warb. medicine has found another specific, this time for the dread disease of leprosy. This oil, called chaulmugra oil, has long been associated with Burmese folklore and tradition as a cure for leprosy. The Buddhist histories of a thousand years ago contain a legendary account of one of the kings of Burma who cured himself with the oil from the tree known by the natives as "Kalaw." At the same time he likewise succeeded in removing the curse of leprosy from a woman who afterwards became his queen.

Chaulmugra oil was early recognized by the Indian pharmacopoeia. It was valued in both India and China as a remedy for skin diseases and other complaints due to impurities of the blood. In Mauritius it was regarded as the only remedy for leprosy, and so high a value was placed upon its purity that seed were imported direct from India in order to prevent adulteration.

About the middle of the last century certain Englishmen became interested in the reported efficacy of chaulmugra oil, and a considerable number of trials were made calculated to test the real value of the remedy. Not only was it recommended for leprosy, but great claims were made for its use in rheumatism, neuralgia, toothache, sciatica, eruptions of

the skin, and more especially, for tuberculosis and veterinary cases. It is not to be wondered that such a universal panacea speedily fell into disrepute, particularly since the seed from which the oil was extracted were obtained from the wrong tree. Thomas Christy, in his "New Commercial Plants," published in 1878, figures and describes at some length *Gynocardia odorata* as the source of chaulmugra oil, thus perpetuating the original unfortunate blunder. By 1884 there were other seed on the market supposed to furnish chaulmugra oil, and it is certain that *Hydnocarpus Wightiana* was believed to possess similar properties to those of the true chaulmugra oil tree. There was no demand, however, for these seed nor for the oil they contained.

About 1899 the real source of chaulmugra oil was discovered, and three years later investigations were again undertaken in London to determine, if possible, the value of this oil in medicine. The active principle of chaulmugra oil was isolated, and experiments carried on with lepers, chiefly in Hawaii, seemed to indicate that in cases not too far advanced a very high percentage of the patients might be permanently cured. Similar favorable reports have been received from other parts of the world. In Siam all lepers who have been fortunate enough to receive treatment are believed to have recovered absolutely, the only difficulty being that the supply of oil is inadequate to meet the large demand and at present the number of cures is disproportionately small.

Hydnocarpus Kurzii, the tree which produces the true chaulmugra oil, is an evergreen growing to a height of seventy-five feet or more and bearing fruit as large as an orange, within which are imbedded the valuable seed. It occurs abundantly along the banks of streams in the dense tropical jungles of Upper Burma and Assam. In 1919, The Missouri Botanical Garden received, through the efforts of Mr. Calder, Director of the Royal Botanic Garden, Sibpur, Calcutta, two large shipments of seed of *H. Kurzii*, one of one and three-fourths pounds from Moulmein, Burma, and one of three pounds from Upper Assam. These were carefully packed in charcoal and sealed in lead containers so that they arrived in excellent condition, and as a consequence there are now growing at the Garden a number of seedlings of this tree. There has likewise been received within the last year seed of the same species, as well as of *Hydnocarpus anthelmintica*, collected by Mr. J. F. Rock, Agricultural Ex-

FLOWER OF MONSTERA DELICIOSA.

FRUIT OF MONSTERA DELICIOSA.

plorer of the Office of Foreign Seed and Plant Introduction, United States Department of Agriculture.

Obtaining the seed for chaulmugra oil is a difficult operation. The forests in which *H. Kurzii* grows are so dense that it is frequently impossible to penetrate them for any distance. Even after the trees are found, not more than one out of a hundred may possess ripe fruit and when the ripened fruit falls it is frequently consumed by wild animals. In addition to these difficulties, the jungle is inhabited by tigers, bears, and elephants so that the natives will not venture into it unless they go in large crowds. Not infrequently the hunt may result in the loss of several lives. However, should the remedy prove to be as effective as the preliminary experiments seem to indicate, there is no reason to suppose that with an increased demand all the seeds necessary to supply the world with chaulmugra oil for the cure of leprosy may not eventually be obtained.

THE CERIMAN

Monstera deliciosa, commonly called ceriman, is a climber native of Mexico and Guatemala. It attaches itself to trees by numerous tenacious roots, and as it climbs sends out long, rope-like, aerial roots which sometimes reach the ground. The stems are thick, woody, and dark green in color. In the young stage the leaves resemble those of the genus Philodendron, being small, entire, and pinnate, but later they become conspicuously large and perforated. The flowers are very striking, in shape suggesting the calla lily, with spathe and spadix white. After pollination the spathe changes from white to green, then to brown, and eventually it drops off, the edible seeds being developed in the cylindrical spadix. When ripe the fruit resembles a pine cone and often measures a foot in length. The outer covering is composed of a series of hexagonal green plates which later fall off, exposing the slightly albuminous yellow seeds. These seeds are very delicious, with a flavor resembling both pineapple and banana and an odor strikingly like the pineapple. Twelve months must elapse between the expanding of the flower and the ripening of the fruit.

The ceriman grows satisfactorily in both cool and tropical greenhouses, and, due to its ability to endure varied conditions of temperature, young plants may be grown as pot plants in the house. To obtain fruiting specimens, however, the plants must be grown in a tropical greenhouse

and planted directly in the ground adjacent to a wall upon which they may attach themselves. Like most araceous plants they require an abundance of moisture upon the leaves and roots. The plants may be propagated from the terminal growth or by cutting up the old stem, each node possessing a dormant eye. The cuttings are placed in moss with bottom heat and when new roots appear from the under portion of the stem they should be potted into small pots in a sandy loam soil.

Fruiting specimens of the ceriman in various stages may be seen at the Garden, the older plants attracting much attention on account of the size and perforations of the leaves. Several plants showing both aerial and supporting roots may be observed climbing upon the concrete wall on the north side of the aroid house. In the fern house a specimen is growing from the grotto adjacent to the waterfall, an excellent view of combined foliage, flowers, and fruit being obtained upon entering the south door. In the palm house specimens are planted at the base of the large iron girders upon which the plants are climbing.

HARDY EXOTIC PLANTS SUITABLE FOR THE GARDENS OF MISSOURI AND ADJOINING STATES.

(Continued from June Bulletin)

IX. PERENNIALS FOR THE BORDER

Botanical name	Common name	Approx. height	Color of flowers	Approx. time of bloom	Habitat
Achillea Eupatorium	Yarrow	1-2′	Yellow	July-Sept.	Europe
Achillea filipendulina	Yarrow	6-18″	Yellow	June-Sept.	Orient
Achillea macrophylla	Yarrow	2-3′	Yellow	July-Aug.	Europe
Achillea Ptarmica	White tansy	6-18″	White	June-Sept.	N. temp. regions
Achillea tomentosa	Yarrow	8-10″	Yellow	July-Aug.	Europe
Achillea Tournefortii	Yarrow	12-18″	Pale yellow.	June-July.	Greece
Aconitum Anthora	Aconite	1-2′	Pale yellow.	June-July.	Europe

Botanical name	Common name	Approx. height	Color of flowers	Approx. time of bloom	Habitat
Aconitum autumnale	Autumn aconite	3-4′	Lilac or white	Sept.-Nov.	China
Aconitum Lycoctonum	Aconite	1-2′	Yellow	June-Sept.	Siberia
Aconitum Napellus	Aconite	3-4′	Blue	June-July	Europe
Ajuga reptans	Bugle-weed	Trailing	Blue	June-July	Europe
Althaea rosea	Hollyhock	6-10′	Many colors	Summer	China
Alyssum argenteum	Alyssum	8-15″	Yellow	Summer	Europe
Alyssum saxatile	Alyssum	5-12″	Yellow	April-May	Europe
Anchusa italica var. "*Dropmore*"	Alkanet	3-5′	Blue	June-July	Europe
Anemone japonica	Japanese windflower	1-2′	White	Aug.-Oct.	China, Japan
Anemone Pulsatilla	Pasque flower	9-12″	Blue or purple	April	Europe
Anthemis tinctoria	Golden marguerite	2-3′	Yellow	May-June	England
Aquilegia glandulosa	Columbine	1-1½′	Lilac-blue	May-June	Siberia
Aquilegia sibirica	Siberian columbine	1-2′	Blue	May-June	Siberia
Aquilegia vulgaris	European columbine	1-2′	Violet	Summer	Europe, Siberia
Armeria plantaginea	Sea pink	8-12″	Pink	June-Aug.	Europe
Artemisia argentea	Artemisia	1-2′	Whitish	June-July	Madeira
Aster Amellus and varieties	Aster	2-4′	Purple	Sept.-Oct.	Europe, Asia
Aster tataricus	Tartarian aster	3-5′	Purple	Sept.-Oct.	Siberia
Astilbe chinensis	Chinese goat's-beard	1-2′	Pink	July-Aug.	China
Astilbe japonica	Japanese goat's-beard	1-2′	White	June-July	Japan
Belamcanda chinensis	Blackberry lily	2-3′	Orange	June	China
Bocconia cordata	Plume poppy	4-8′	Pinkish	May-June	China, Japan
Campanula carpatica	Bell-flower	2-3′	Blue	July-Sept.	Austria
Campanula pyramidalis	Chimney campanula	2-3′	Blue	June-July	Austria
Centranthus ruber	Red valerian	1-3′	Red	May-Aug.	Europe

Botanical name	Common name	Approx. height	Color of flowers	Approx. time of bloom	Habitat
Cerastium Biebersteinii	Grasswort	Trailing	White	June-July	Asia
Cerastium tomentosum	Grasswort	Trailing	White	June-July	Europe
Chrysanthemum coccineum and varieties	Pyrethrum	1-2′	White, red to crimson	May-Aug.	Persia
Chrysanthemum indicum and varieties	Hardy chrysanthemum	1-3′	Many colors	Oct.-Nov.	China, Japan
Chrysanthemum Leucanthemum var. *hybridum*	Shasta daisy	1-2′	White	May-July	Gardens
Clematis heracleaefolia var. *Davidiana*	Herbaceous clematis	2-3′	Blue	July-Aug.	Asia Minor
Coronilla cappadocica	Crown vetch	8-12″	Yellow	July-Aug.	Asia Minor
Coronilla varia	Crown vetch	1-3′ Trailing	Pink or white	June-Oct.	Europe
Delphinium Belladonna	Larkspur	2-3′	Blue	June-Sept.	Gardens
Delphinium formosum	Larkspur	2-3′	Blue	May-Aug.	Asia Minor
Delphinium grandiflorum	Larkspur	2-3′	Blue, white	June-Aug.	Siberia
Dianthus barbatus	Sweet William	10-18″	Many colors	May-June	Europe, Asia
Dianthus caryophyllus	Carnation	1-3′	Various colors	Summer	China, Japan
Dianthus chinensis and varieties	Pink	8-15″	Various colors	Summer	China, Japan

Botanical name	Common name	Approx. height	Color of flowers	Approx. time of bloom	Habitat
Dianthus deltoides	Maiden pink	6-10"	Red with crimson eye	Summer	Europe, Japan
Dianthus plumarius	Garden pink	6-12"	Various colors	Summer	Europe, Siberia
Dicentra spectabilis	Bleeding heart	12-18"	Rose-red	May-June	Japan
Dictamnus albus	Gas plant	2-3'	White	May-June	Europe, Asia
Dictamnus albus var. *rubra*	Gas plant	2-3'	Rose-purple	May-June	Europe, Asia
Digitalis ambigua	Yellow foxglove	2-3'	Yellowish	May-June	Europe, Asia
Digitalis purpurea	Common foxglove	2-4'	Rose and white	May-June	Europe
Digitalis purpurea var. *gloxiniaeflora*	Foxglove	3-5'	Purple, white	May-June	Gardens
Doronicum plantagineum	Leopard's bane	1-3'	Yellow	April-June	Europe
Echinops Ritro	Globe thistle	2-4'	Steel-blue	July	Europe
Erigeron aurantiacus	Flea-bane	6-10"	Orange	July-Aug.	Turkestan
Eryngium amethystinum	Sea holly	2-3'	Purplish	July-Sept.	Europe
Eryngium planum	Sea holly	2-3'	Purplish	July-Sept.	Europe, Asia
Filipendula camtschatica	Meadow-sweet	2-4'	White	July	Manchuria
Filipendula hexapetala	Meadow-sweet	1-3'	White	June-July	Europe, Asia
Filipendula palmata	Meadow-sweet	2-3'	Pink	July	Asia
Filipendula purpurea and varieties	Meadow-sweet	2-3'	Carmine, pink and white	June-Aug.	Japan
Funkia Fortunei	Fortune's plantain lily	1-2'	Lilac	July	Japan
Funkia lancifolia	Lance-leaved plantain lily	8-18"	Lilac	July-Sept.	Japan
Funkia ovata	Plantain lily	6-18"	Lavender	June-July	Japan
Funkia Sieboldiana	Siebold's plantain lily	1-2'	Lilac	June-July	Japan

Botanical name	Common name	Approx. height	Color of flowers	Approx. time of bloom	Habitat
Funkia subcordata	White plantain lily	1-2′	White	Aug.-Sept.	Japan
Galega officinalis	Goat's rue	2-3′	Purplish blue	July-Aug.	Europe, Asia
Geranium sanguineum	Crane's-bill	6-12″	Red	May-Aug.	Europe
Geum chiloense	Geum	6-12″	Bright red	May-June.	South America
Geum reptans	Avens	Creeping.	Yellow	May-June.	Europe
Gypsophila paniculata	Baby's breath	2-3′	White	Summer.	Europe
Hemerocallis Dumortierii	Day-lily	1-2′	Orange	May-June.	Japan
Hemerocallis flava	Lemon lily	1-2′	Deep yellow	June-July.	Europe, Asia
Hemerocallis fulva	Homestead lily	1-3′	Orange	May-July.	Europe
Hemerocallis Middendorfii	Middendorf's yellow day-lily	12-18″	Yellow	May-June.	Asia
Iberis sempervirens	Evergreen candytuft	8-12″	White	April-June.	Crete
Inula grandiflora	Elecampane	2-3′	Orange-yellow	June	Asia
Inula Helenium	Elecampane	3-5′	Yellow	June-July.	Europe
Iris, mostly all species and varieties	Iris	4″-4′	Many colors	April-July	
Kniphofia aloides var. *Pfitzeri*	Flame-flower	1-3′	Coral-red.	July-Oct.	Africa
Lespedeza bicolor	Bush clover	1-2′	Pinkish purple	Aug.-Sept.	Japan
Lespedeza japonica	Bush clover	2-3′	White	Sept.-Oct.	Japan
Lespedeza Sieboldii	Siebold's bush clover	2-3′	Rose	Aug.-Sept.	Japan
Linaria vulgaris	Butter-and-eggs	1-2′	Sulphur-yellow	May-Sept.	Europe
Linum perenne	Flax	1-2′	Blue	Summer.	Europe
Lychnis chalcedonica	Maltese cross	2-3′	Scarlet	June	Japan
Lychnis Flos-cuculi	Cuckoo flower	1-2′	Red or pink	Summer.	Europe, Asia
Lychnis Haageana	Lychnis	1-2′	Scarlet. red or crimson.	Summer.	Gardens

Botanical name	Common name	Approx. height	Color of flowers	Approx. time of bloom	Habitat
Lysimachia clethroides	Loosestrife	2-3′	White	July-Sept.	Japan
Lysimachia Nummularia	Moneywort	Trailing	Yellow	June-Aug.	Europe
Lythrum Salicaria and varieties	Purple loose-strife	3-5′	Purple and rose	June-Aug.	Australia
Malva rotundifolia	Common mallow	Trailing	Whitish	Summer	Europe
Mentha spicata	Spearmint	1-2′	White	Summer	Europe, Asia
Nepeta Glechoma	Ground ivy	Creeping	Blue	Summer	Europe, Asia,
Nierembergia rivularis	White-cup	4-6″	White	July-Sept.	South America
Omphalodes verna	Creeping forget-me-not	4-6″	White	April-May	Europe
Paeonia, all species and varieties	Peony	1-3′	Many colors from white to crimson	May-June	Europe, Asia
Papaver orientale and varieties	Oriental poppy	2-3′	White, pink, scarlet	June-July	Asia Minor
Platycodon grandiflorum	Balloon flower	1-2′	Blue and white	Summer	China, Japan
Potentilla nepalensis	Potentilla	1-2′	Red	May-June	Asia
Potentilla pyrenaica	Potentilla	6-15″	Yellow	August	Europe
Ranunculus aconitifolius	White buttercup	2-3′	White	May-June	Europe
Ranunculus bulbosus	Bulbous buttercup	2-3′	Bright yellow	April-Aug.	Persia, Europe
Ranunculus repens	Creeping buttercup	Creeping	Yellow	May-July	Europe, Asia
Salvia argentea	Silvery sage	2-4′	Whitish	Summer	Europe

Botanical name	Common name	Approx. height	Color of flowers	Approx. time of bloom	Habitat
Salvia pratensis	Sage	1-3′	Blue	Aug.-Sept.	England
Saponaria officinalis	Bouncing Bet	1-2′	Light pink	Summer	Europe
Scabiosa caucasica	Mourning bride	12-18″	Light blue	July-Aug.	Caucasus
Scutellaria orientalis	Oriental skull-cap	1-2′	Purplish	Aug.-Sept.	Asia Minor
Sedum acre	Wall pepper	2-3′	White	June-July	Europe, Asia
Sedum Aizoon	Live-forever	8-16″	Yellow	July-Aug.	Siberia
Sedum Maximowiczii	Live-forever	8-16″	Yellow	July-Aug.	Japan
Sedum roseum	Live-forever	4-8″	Rose	July-Aug.	Europe, Africa
Sedum spectabile	Showy sedum	12-18″	Purplish	Sept.-Oct.	Japan
Senecio Cineraria	Dusty groundsel	1-2′	Yellow	June-July	Europe
Senecio japonicus	Groundsel	3-5′	Orange	Summer	Japan
Silene Schafta	Autumn catchfly	4-8″	Purple	June-Oct.	Caucasus
Statice latifolium	Sea lavender	12-18″	Light blue	July-Aug.	Russia
Statice speciosum	Sea lavender	6-12″	White	July-Aug.	Siberia
Statice tataricum	Sea lavender	1-2″	Red	July-Aug.	Caucasus
Symphytum officinale	Comfrey	1-2′	Yellow	June-July	Europe, Asia
Thalictrum aquilegifolium	Feathered meadow rue	2-3′	Whitish purple	May-July	Europe, Asia
Thalictrum minus var. *adiantifolium*	Meadow rue	1-2′	Yellowish white	June-July	Europe, Asia, Africa
Thalictrum petaloideum	Meadow rue	1-2′	Pinkish white	June-July	Asia
Tritonia crocosmaeflora and varieties	Tritonia	2-3′	Orange to crimson	May-June	Gardens
Tritonia Pottsii	Tritonia	2-3′	Yellow, tinged red	May-June	Africa
Tritonia rosea	Blazing star	1-2′	Red	May-June	Africa
Valeriana montana	Valerian	1-2′	Bright rose	May-June	Europe

Botanical name	Common name	Approx. height	Color of flowers	Approx. time of bloom	Habitat
Valeriana officinalis	Common valerian.	2-3′	Pinkish white	May-June.	Europe, Asia
Veronica amethystina	Speedwell	1-2′	Blue	May-June.	Europe
Veronica Chamaedrys	Bird's-eye speedwell	8-12″	Blue	May-June.	Europe
Veronica circaeoides	Speedwell	3-6″	Blue	May-June.	Switzerland
Veronica gentianoides	Gentia-leaved speedwell	1-3′	Blue	May-June.	Europe
Veronica incana	Speedwell	12-16″	Blue	July-Sept.	Europe, Asia
Veronica longifolia	Speedwell	2-3′	Blue	July-Sept.	Europe, Asia
Veronica longifolia varieties	Speedwell	18-30″	Blue and pinkish.	Aug.-Sept.	Europe, Asia
Veronica spicata and *varieties*	Speedwell	2-3′	Blue, white, and pink	June-Aug.	Europe, Asia
Veronica repens	Creeping speedwell	Creeping.	Blue	May	Corsica
Vinca minor	Periwinkle	4-6′ Trailing.	Blue	April-May.	Europe
Viola odorata and varieties	Sweet violet	6-12″	Blue, white, and pinkish.	Spring and autumn.	Europe, Asia, Africa

NOTES

Recent vistors to the Garden include Mr. A. D. Taylor, landscape architect of Cleveland, Ohio; Mr. Lyman Carriere, Agronomist, Bureau of Plant Industry, U. S. Department of Agriculture; Dr. Olaf Arrhenius, plant physiologist, Stockholm, Sweden; Professor Kingo Miyabe, Professor of Botany and Director Botanic Garden, Hokkaido Imperial University, Sapporo, Japan; Dr. E. J. Butler, Director of the Imperial Bureau of Mycology, Kew, England; Mr. M. Shapovalov, of the Bureau of Plant Industry, U. S. Department of Agriculture, and Dr. C. V. Piper, of the U. S. Department of Agriculture.

The July number of Parks and Recreation contains an article on "Indoor Plant Collections at the Misouri Botanical Garden," by Mr. G. H. Pring, Horticulturist to the Garden, and one on "Hardy Herbaceous Plants for Parks," by Mr. L. P. Jensen, Aboriculturist to the Garden.

Mr. L. P. Jensen attended the convention of the American Association of Park Superintendents, Detroit, August 23-25, and presented a paper, August 24, on "The Value of Parks to Posterity." He was elected a member of the Board of Directors of the above association for a term of three years and reappointed associate editor of Parks and Recreation for a two-year term.

At the meeting of the Pacific Coast section of the American Society of Naturalists in Berkeley, August 3-5, Dr. B. M. Duggar, Physiologist to the Garden, presented two papers relating to plant nutrition, as follows: "Some Phases of Metabolism in the Fungi" and "The Effects of Certain Colloids on the Salt Requirements of Seed Plants."

Dr. G. M. Armstrong, formerly Rufus J. Lackland fellow, who received his doctorate in botany at the commencement of Washington University in June, has been appointed instructor in botany at the University for 1921-22.

Students entering upon work in the graduate laboratory for the academic year are as follows:

Rufus J. Lackland Fellows.—Mr. Arthur F. Camp, A. B. University of California, assistant in plant pathology, University of California; Mr. Leo Joseph Klotz, B. S. and M. S. Michigan Agricultural College; Mr. H. R. Rosen, B. S. Pennsylvania State College, M. S. University of Wisconsin, associate professor in plant pathology, University of Arkansas;

Mr. F. S. Wolpert, A. B. University of Montana, reappointed third year.

Jessie R. Barr Fellows.—Miss Mildred L. Johnson, B. S. Oregon Agricultural College, assistant in botany, University of Oregon; Miss Grace Elizabeth Howard, A. B. and M. S. University of Washington, graduate assistant, University of Washington.

Teaching Fellow.—Mr. Carl George Deuber, B. S. University of Missouri.

Teaching Fellow and Research Assistant.—Joanne L. Karrer, B. S. and M. S. University of Washington, Ph. D. Washington University.

Miss Cora A. Mautz, B. A. University of Wisconsin, now instructor in botany at the Principia School, St Louis, is also registered for graduate work.

The first number of Volume VIII of the Annals of the Missouri Botanical Garden has been issued with contents as follows:

"Physiological Specialization in Rhizoctonia Solani Kühn." Takashi Matsumoto.

"The Effect of Hydrogen Ion Concentration upon the Accumulation and Activation of Amylase Produced by Certain Fungi." Joanne L. Karrer.

STATISTICAL INFORMATION FOR JUNE—AUGUST, 1921

GARDEN ATTENDANCE:

Total number of visitors in June	13,965
Total number of visitors in July	17,871
Total number of visitors in August	22,363

PLANT ACCESSIONS:

Total number of plants and seeds received as gifts in June	73
Total number of seed packets received in exchange in July	20
Total number of plants and seeds received as gifts in August	15

PLANT DISTRIBUTION:

Total number of plants and seeds distributed as gifts in June	800
Total number of plants and seeds distributed as gifts in July	57

LIBRARY ACCESSIONS:

Total number of books and pamphlets bought in June	42
Total number of books and pamphlets donated in June	41
Total number of books and pamphlets bought in July	12
Total number of books and pamphlets donated in July	37
Total number of books bought in August	52
Total number of books and pamphlets donated in August	365

HERBARIUM ACCESSIONS:

JUNE

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- Dr. G. R. Bisby—Fungi of Manitoba..... 36
- Brooklyn Botanic Garden, by Dr. Norman Taylor—*Polyachrus sphaerocephalus* D. Don from San Gallan Island, Peru..... 1
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- Dr. B. M. Duggar—Plants of Missouri, including cultivated specimens 35
- Dr. J. M. Greenman—Plants of St. Louis County, Missouri 5
- C. J. Humphrey—Hydnaceous fungi..... 95
- John Kellogg—Cultivated specimen of *Nepeta melissaefolia* Lam..... 1
- Dr. F. J. Seaver—Thread blight from Trinidad..... 1
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JULY

By Gift—
- J. A. Drushel—Plants of Alabama, Missouri, Texas, and Colorado 25
- W. W. Gardner—*Lippia nodiflora* (L.) Michx. from Arkansas 1
- Walter H. Gerke—Cultivated specimen of *Yucca* sp. from Oregon 1
- O. S. Ledman—*Helenium tenuifolium* Nutt. from Missouri 1
- F. McAllister—*Isoetes* sp. from Texas..... 1
- Charles E. Prunty—Cutlivated specimen of *Agrostis capillaris* L. from Missouri..... 2

By Purchase—
- L. A. Kenoyer—Plants of the Himalayas..... 528
- L. A. Kenoyer—Plants of the Gangetic Plains..... 187

746

AUGUST

By Gift—
- O. S. Ledman—*Euphorbia humistrata* Engelm. from Illinois 1
- Oscar P. Taylor—*Dirca palustris* L. from Oklahoma.... 1

By Exchange—
- National Herbarium, Pretoria, by Mr. E. Percy Phillips—Plants of South Africa..... 51

New York Botanical Garden—Plants of the West Indies	3	
		56
Total		1207

The Garden is open to the public every day in the year, except New Year's, Fourth of July, Labor Day, and Christmas—week days from 8:00 A. M. until one-half hour after sunset; Sundays from December to April, 1:00 P. M. until sunset, from April to December, 2:00 P. M. until sunset.

The main entrance to the Garden is located at Tower Grove Avenue and Flora Boulevard, on the Vandeventer Avenue car line. Transfer south from all intersecting lines.

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1921

MISSOURI BOTANICAL GARDEN BULLETIN

Vol. IX OCTOBER, 1921 No. 8

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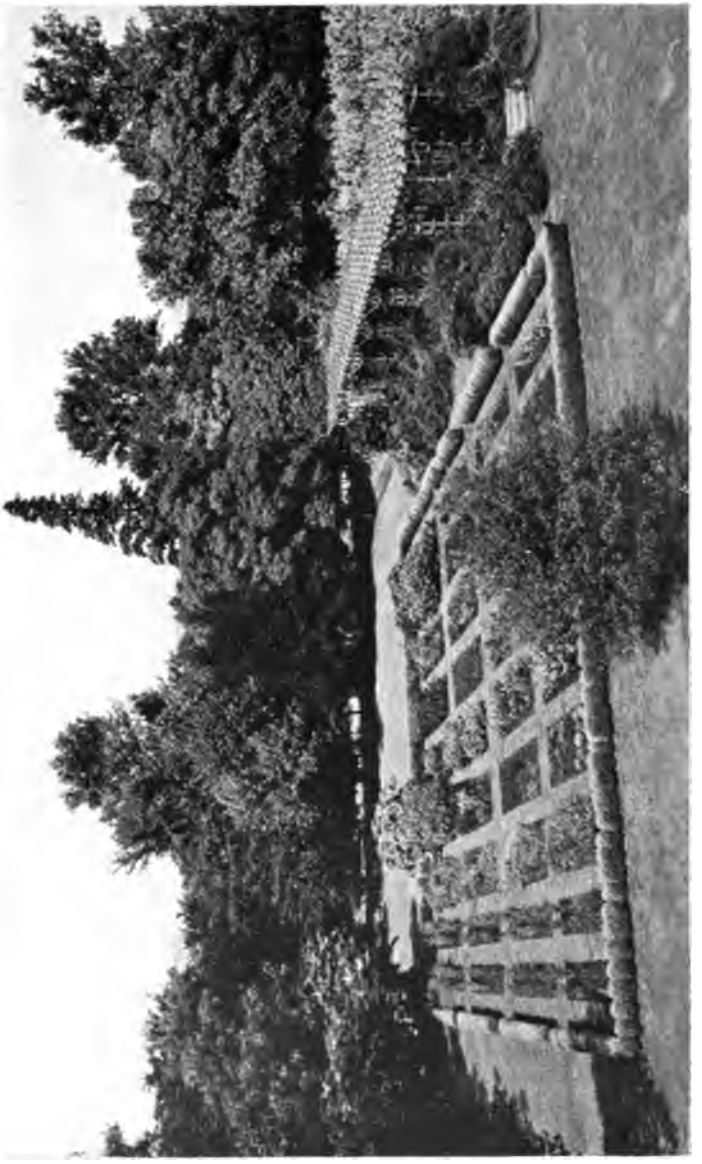

VIEW OF TEST GARDEN.

Missouri Botanical Garden Bulletin

Vol. IX St. Louis, Mo., October, 1921 No. 8

TEST GARDEN, 1921

The climatic conditions of the past summer were extremely trying to plant growth. Plants in the test garden not accustomed to extreme heat died within two weeks from the time of planting, and while slightly stronger ones succeeded in living during the summer, making their best growth in September, it was only the tropical varieties, such as the Ricinus, that fairly thrived in the heat.

The test garden (pl. 24) was surrounded with a hedge of *Kochia trichophylla.* These plants were started April 5 and planted in the garden June 3. They made a quick growth, and with a little shearing, produced a good hedge. For the past two summers the experience at the Garden has been that if Kochia is watered during the dry periods it will continue to remain green until checked by frost. These plants at the Garden demonstrated well what can be accomplished with an annual to produce a hedge effect in one season.

Alyssum maritimum "Lilac Queen" proved meritorious only towards the close of the season. During the summer the flowers faded quickly, but in September and October the true lilac color appeared, producing quite a contrast with the pure white "Little Gem." This plant would probably do better during a cooler season.

In the early summer the antirrhinums produced one good crop of flowers, but during the remainder of the season bloomed intermittently although the growth was strong. Their colors were brilliant, but in quantity of bloom the flowers did not compare with those of the previous year.

Calliopsis elegans "California Golden Wave" and *C. elegans* var. *nana* "The Garnet" both produced many flowers during the early summer, but few thereafter.

The majority of the asters grew well and, without doubt,

"Heart of France" surpassed them all. It is a good red, the large flowers being borne on long and strong stems. "Peerless Yellow" did well, but under the intense sun the blooms faded after fully expanding. "Cerise Rochester" also is a desirable sort worthy of mention. The blister beetle (*Epicauta pennsylvanica*) was extremely active this season, and the tarnished plant bug (*Lygus pratensis*) damaged the blooms considerably.

No cannas were grown in the test garden, but this is an opportune time to say a few words about "The President." This canna was observed in the East during the summer of 1920. It appeared so vigorous and healthy and possessed so many merits that it was decided to use it in the main garden without first giving it a trial. During the summer of 1921, when conditions were most unfavorable for many plants, "The President" exceeded all expectations. The flowers were large, of good color and substance, and bloomed freely from spring until frost, and the foliage was vigorous.

Celosia Childsii and its pink variety both produced many large heads of bloom during the latter part of August and September. They have few equals for brilliant masses of color during late summer.

Coleus from seed are always interesting when new colors are desired. One of those grown this year, a yellow-stemmed plant with red foliage edged with yellow, appears to be worthy of further trial and is being propagated to test its suitability for bedding purposes.

Seeds of *Dahlia maxonii*, No. 49757, sent by the United States Government, were sown March 8. The plants grew vigorously and produced larger foliage than any dahlias in the Garden, but did not flower. This dahlia occurs wild and cultivated in many parts of the Guatemalan highlands and was collected by Mr. Wilson Popenoe, Agricultural Explorer. In the wild state the flowers are said to be lilac-pink and single, but under cultivation are variable in color and sometimes double. This dahlia will probably flower next season.

Dianthus barbatus "Brilliant Red," left in the test garden from the previous season, bloomed this spring, the flowers being a deep red. This plant cannot be considered a discovery as it has no special merits. *D. plumarius* "Snowball" was a free bloomer. The majority of the flowers were double and white, as advertised, but a few mixed appeared, these being equally as attractive as the white.

The annual *Gaillardia pulchella* "The Bride" bloomed freely throughout the summer, the flowers being of a lemon-yellow color.

The sunflowers, *Helianthus annuus* "Dazzler" and "Excelsior Miniature Hybrids" grew to a height of six feet. During the greater part of the summer they were in full bloom, the flowers containing various shades of red and orange, and measuring about six inches across.

Hibiscus sp., No. 46459, sent by the United States Government, grew to a height of three feet. When grown under glass the plants were normal, but outdoors the leaves were malformed and the plant did not bloom. No trace of an insect could be found that might have caused some injury. This hibiscus was collected in Burringbar, New South Wales. It is a native of Australia where it attains a height of twelve feet, the large leathery foliage being eaten by stock.

Due to the heat, the sweet peas grown in the early spring were a failure, although the previous year they bloomed abundantly until July 1. Best results have been obtained when the plants were started indoors in February.

The "Flanders Field Poppy," *Papaver Rhoeas,* was grown in the test garden in 1920 and proved successful. It was not intended to be grown a second season, but as it reseeded itself and the plants were so thrifty, it was allowed to remain. The latter part of May the plants were in full bloom, the flowers being twice the size and of a better color than those of the previous year.

Potentilla Mooniana, No. 47763, was received from the United States Government on February 1. At that time it appeared to be a valuable plant for formal bedding, the white leaves forming a rosette and resembling *Centaurea gymnocarpa* in color. After setting out, however, the plant gradually deteriorated and after lifting in the fall finally died.

On March 5 the United States Government sent three seeds of castor bean (*Ricinus communis,* No. 49366) from Mexico where it is said to grow wild in certain regions. The seeds were very large, being 7/10 of an inch long and 3/5 of an inch wide. These were sown April 25 and planted in the test garden June 9. The three plants are shown in pl. 25, fig. 1, photographed October 1, at which time they had attained a height of thirteen feet, the leaves measuring two and three feet across. The plants were very slow in producing seed and it is doubtful whether any will ripen before frost.

The other extreme in castor beans is shown in pl. 25, fig. 2.

The origin and species of this Ricinus is not known, a solitary plant appearing in the Garden in 1920. The small seeds, measuring 3/8 of an inch long and 3/16 of an inch wide, are produced in abundance, the flowers appearing when the plants are only two feet tall. This castor bean grows to a height of six feet, the leaves measuring six to twelve inches across. The green leaves and seed pods and the glaucous stalks give this entire plant a gray-green appearance. This is a valuable Ricinus for garden planting where tropical effects are desired. It is a rapid grower, branches freely, and, unlike the taller sorts, retains its basal foliage, making it a good subject for use either as a background or for planting in the fore part of a bed.

The "Blue Lace Flower," *Trachymene caerulea,* was a pretty little flower while it lasted. The plants grew well, attained a height of a foot, and each bore a number of flowers. Immediately after flowering, however, all died without ripening any seed, the climatic conditions being too severe for such a delicate plant.

Verbena hybrida var. *grandiflora* "Ellen Willmott" and "New Giant-flowered Mixed" were both excellent bloomers.

During the summer of 1922 it is proposed to give cannas, delphiniums, and peonies a leading place in the test garden.

The following is a list of the plants grown in the test garden during the summer of 1921:

Aegopodium Podograria variegatum
Agathaea coelestis
Alyssum maritimum "Little Queen"
Alyssum maritimum "Little Gem"
Anchusa hybrida "New Annual Blue"
Antirrhinum majus "Canary Bird"
Antirrhinum majus "Cattleya"
Antirrhinum majus "Copper King"
Antirrhinum majus "Diamond"
Antirrhinum majus "Golden Queen"
Antirrhinum majus "Snowflake"
Antirrhinum majus "The Rose"
Calceolaria mexicana
Calendula officinalis "Improved Orange"
Calliopsis elegans "California Golden Wave"
Calliopsis elegans var. nana "The Garnet"
Callistephus chinensis "American Beauty"
Callistephus chinensis "Cerise Rochester"
Callistephus chinensis "Heart of France"
Callistephus chinensis "Peerless Yellow"
Callistephus chinensis "Pink Enchantress"
Callistephus chinensis "Royal White"
Callistephus chinensis "Silvery Rose"

GIANT CASTOR BEAN.

DWARF CASTOR BEAN.

Celosia Childsii, crimson
Celosia Childsii, pink
Celosia cristata "Glasgow Prize"
Centranthus macrosiphon
Chrysanthemum Burridgeanum
Chrysanthemum hortorum "Adelaide"
Chrysanthemum hortorum "Harriet Sykes"
Chrysanthemum hortorum "Shaker Lady"
Chrysanthemum hortorum "Traveler"
Chrysanthemum maximum "Mayfield Giant"
Chrysanthemum tricolor, double white
Chrysanthemum tricolor, scarlet
Chrysanthemum tricolor, single mixed
Chrysanthemum tricolor, white
Coleus sp.
Cosmos bipinnatus, double-flowered crimson
Cosmos bipinnatus, double-flowered pink
Cosmos bipinnatus, double-flowered white
Dahlia maxonii, U. S. Govt. No. 49757
Dahlia rosea, double yellow
Dahlia rosea, single mixed
Delphinium Ajacis "Blue Gem"
Delphinium Ajacis "Rosy Scarlet"
Delphinium Ajacis "Victory"
Dianthus barbatus "Brilliant Red"
Dianthus Caryophyllus, blue
Dianthus Caryophyllus "New Giant"
Dianthus plumarius "Snowball"
Gaillardia pulchella "The Bride"
Gladiolus hybridus "America"
Gladiolus hybridus "Baron Hulot"
Gladiolus hybridus "Delice"
Gladiolus hybridus "Empress of India"
Gladiolus hybridus "Golden King"
Gladiolus hybridus "Lily Lehman"
Gladiolus hybridus "Mrs. F. King"
Gladiolus hybridus "Mrs. F. Pendleton"
Gladiolus hybridus "Niagara"
Gladiolus hybridus "Panama"
Gladiolus hybridus "Peace"
Gladiolus hybridus "Princeps"
Gladiolus hybridus "Schwaben"
Gladiolus hybridus "Willy Wigman"
Gladiolus primulinus "Autumn Glory"
Gladiolus primulinus "Bronze Queen"
Gladiolus primulinus "Distinction"
Gladiolus primulinus "Enchantress"
Gladiolus primulinus "Fairy Queen"
Gladiolus primulinus "Lemon Queen"
Gladiolus primulinus "Pres. Wilson"
Gladiolus primulinus "Sunrise"
Gladiolus primulinus "Vesuvius"
Helianthus annuus "Dazzler"
Helianthus annuus "Excelsior Miniature Hybrids"
Hibiscus sp. U. S. Govt. No. 46459

Hibiscus Manihot "Giant Mallow"
Hibiscus roseus chinensis punicens
Kochia trichophylla
Lathyrus odoratus "Austin Frederick"
Lathyrus odoratus "Barbara"
Lathyrus odoratus "Blue Monarch"
Lathyrus odoratus "Constance Hinton"
Lathyrus odoratus "Hercules"
Lathyrus odoratus "Ivorine"
Lathyrus odoratus "Mrs. J. Balmer"
Lathyrus odoratus "Old Rose"
Lathyrus odoratus "The Cardinal"
Lathyrus odoratus "The President
Lathyrus odoratus "Warrior"
Lilium regale
Lobelia Erinus var. compacta "Blue Bird"
Papaver Rhoeas "Flanders Field Poppy"
Petunia hybrida, blue
Petunia hybrida "Glory"
Petunia hybrida "Howard's Star"
Petunia hybrida "Inflata"
Petunia hybrida "Pink Beauty"
Petunia hybrida "Rosy Morn"
Portulaca grandiflora, double mixed
Potentilla Mooniana, U. S. Govt. No. 47763
Ricinus communis, U. S. Govt. No. 49366
Ricinus sp. dwarf green
Salpiglossis sinuata, dark scarlet
Salpiglossis sinuata "Improved Emperor Strain"
Salpiglossis sinuata, light blue and gold
Salpiglossis sinuata, pink
Salpiglossis sinuata, pure golden yellow
Salvia splendens "Ostrich Plume"
Salvia splendens, purple
Senecio elegans, flesh color
Senecio elegans, lilac
Senecio elegans, purple
Senecio elegans, white
Tagetes erecta "Orange Prince"
Tagetes patula, var. nana "French mixed"
Trachymene caerulea "Blue Lace Flower"
Verbena hybrida grandiflora "Ellen Willmott"
Verbena hybrida grandiflora "New Giant-flowered Mixed"
Zinnia elegans "Giant Dahlia-flowered"
Zinnia elegans "Mixed Victory"
Zinnia elegans "Red Riding Hood"

HELIANTHUS ANGUSTIFOLIUS

One of the most showy perennials during the months of October and November, or until the foliage and flowers are killed by heavy frost, is the narrow-leaved sunflower, *Helianthus angustifolius*. This plant has a natural distribution in open swampy land from Long Island to Florida, mainly near the coast, and west to Arkansas and Texas. It varies in height from three to eight feet. The heads are two to three inches broad, with bright yellow rays and purple disks, and are borne few, sometimes solitary, on the slender branched stems. The leaves are long, very narrow, dark green above, paler beneath, rough to the touch.

Under cultivation the growth and habit of *Helianthus angustifolius* are considerably changed. It branches nearer the ground, the delicate dark green leaves making the plant attractive for foreground planting during the entire growing season until autumn when it becomes a mass of yellow flowers. The flowers are very sensitive to the sunlight, changing their position to face the sun during the day. While the native habitat is a rich open swampy ground, the plant adapts itself to the soil conditions of the ordinary garden border provided there is not too much shade.

Helianthus angustifolius is easily propagated from seeds. If these are sown in November or December in a cool greenhouse and the plants carried on in pots during winter and planted out in their permanent positions after danger of frost in the spring, the maximum of growth and flowers will be attained the first year. If sown in the open ground in the spring, however, full-grown blooming plants will not be produced until the year following. Propagation may also be accomplished by taking up the viviparous plants which form around the base of the old stem after flowering and in the spring planting them in the positions where the mature plants are desired. They will then bloom the following autumn.

While this plant was described by Linnaeus in 1753, it has not yet become generally known as a garden subject. Its graceful form, floriferous habit, ease of culture and propagation should make it a general favorite for foreground plantations in shrubberies and for the hardy border. The color of the flowers makes possible many attractive combinations with the various species of white, blue, and purple asters whose season of bloom corresponds to that of the Helianthus.

In 1909 about twenty plants of *Helianthus angustifolius*

collected by Mr. John H. Kellogg at Arkansas Post, on the Arkansas River, were planted in the Garden. In 1918 seeds of the same variety, No. 44103, were sent to the Garden by the Department of Agriculture for trial. The plants have done exceedingly well, producing masses of yellow flowers from about the middle of August until killed by frost (see pl. 26).

NEW HYBRID SPIRAEA

An interesting hybrid spiraea between *Spiraea salicifolia* and *S. Douglasii* has recently appeared in the North American tract where large masses of the parent plants are grown. The new hybrid is a shrub 3½ to 4 feet high, with yellowish brown stem. The leaves are oblong-lanceolate to lanceolate, smooth on both sides, green above, paler on the under side, deeply and sharply serrate. The stamens are twice as long as the petals. The sepals are upright in fruit. The flowers are light rose-pink upon spreading racemes.

This new plant resembles *S. salicifolia* in the spreading inflorescence, upright growth, and the light green color of the under side of the leaves. The serrations along the margins are more intensified, however, extending almost to the petiole. The color of the flowers is intermediate between that of the two parents. *Spiraea Billardi* of the trade is derived from the same parents as the Garden hybrid but in general characters, such as color of flowers, shape of inflorescence or flower spike, and leaves, resembles *S. Douglasii*. Its habit of growth, however, is not pendent as in mature plants of *S. Douglasii* but upright as in *S. salicifolia*.

HARDY EXOTIC PLANTS SUITABLE FOR THE GARDENS OF MISSOURI AND ADJOINING STATES

(Continued from September Bulletin)

XI. PERENNIAL PLANTS FOR NATURALIZING

Botanical name	Common name	Approx. height	Color of flowers	Approx. time of bloom	Habitat
Achillea Eupatorium.	Yarrow	1-2′	Yellow	July-Sept.	Europe
Achillea filipendulina.	Yarrow	6-18″	Yellow	June-Sept.	Orient
Achillea macrophylla.	Yarrow	2-3′	Yellow	July-Aug.	Europe
Achillea Tournefortii	Yarrow	1-1½′	Pale yellow.	June-Aug.	Greece

HELIANTHUS ANGUSTIFOLIUS.

SPIRAEA SALICIFOLIA NEW HYBRID. SPIRAEA DOUGLASII.

Botanical name	Common name	Approx. height	Color of flowers	Approx. time of bloom	Habitat
Ajuga reptans	Bugle-weed	4-6"	Blue	June-July	Europe
Artemisia argentea	Artemisia	1-2'	White	July-Aug.	Madeira
Asperula odorata	Sweet woodruff	4-6"	White	May-June	Europe, Orient
Asperula tinctoria	Woodruff	1-2'	Reddish	July-Sept.	Europe
Aster Amellus and varieties	Aster	2-4'	Purple	Sept.-Oct.	Europe, Asia
Aster tataricus	Tartarian aster	3-5'	Purple	Sept.-Oct.	Siberia
Belamcanda chinensis	Blackberry lily	1-3'	Orange	July-Aug.	China
Bocconia cordata	Plume poppy	6-8'	Pinkish	May-July	China, Japan
Chrysanthemum Leucanthemum	Ox-eye daisy	8-12"	White	May-July	Europe, Asia
Chrysanthemum Parthenium	Feverfew	1-3'	White	May-July	Europe
Coronilla cappadocica	Yellow crown vetch	8-12"	Yellow	July-Aug.	Asia Minor
Coronilla varia	Crown vetch	1-2'	Pinkish or white	June-Oct.	Europe
Doronicum plantagineum	Leopard's bane	1-3'	Yellow	Apr.-June	Europe
Hemerocallis Dumortierii	Orange day-lily	1-2'	Orange	July-Aug.	Japan
Hemerocallis flava	Lemon lily	1-3'	Yellow	June-July	Europe, Asia
Hemerocallis fulva	Homestead lily	1-3'	Orange	July-Aug.	Europe
Hemerocallis Middendorfii	Yellow day-lily	12-18"	Yellow	July-Aug.	Asia
Inula grandiflora	Elecampane	2-3'	Orange-yellow	June	Asia
Inula Helenium	Elecampane	3-5'	Yellow	June-July	Europe
Linaria vulgaris	Butter-and-eggs	1-2'	Sulphur-yellow	May-Sept.	Europe
Lysimachia clethroides	Loosestrife	1-3'	White	July-Sept.	Japan
Lysimachia Nummularia	Moneywort	Creeping	Yellow	June-Aug.	Europe
Lythrum Salicaria and varieties	Purple loose-strife	3-4'	Rose	June-Aug.	Australia
Malva rotundifolia	Common mallow	Trailing	Whitish	Summer	Europe
Mentha spicata	Spearmint	1-2'	White	Summer	Europe, Asia
Nepeta Glechoma	Ground ivy	Trailing	Blue	Summer	Europe,

Botanical name	Common name	Approx. height	Color of flowers	Approx. time of bloom	Habitat
Ranunculus aconitifolius	Buttercup	1-3′	White	May-June	Europe
Ranunculus bulbosus	Bulbous buttercup	1-3′	Yellow	May-July	Europe, Africa
Ranunculus repens	Creeping buttercup	Trailing	Yellow	May-July	Europe, Asia
Saponaria officinalis	Bouncing Bet	1-2′	Light pink	Summer	Europe
Thalictrum aquilegifolium	Meadow rue	1-3′	Whitish purple	May-July	Europe, Asia
Thalictrum minus var. *adiantifolium*	Meadow rue	1-2′	Yellowish white	June-July	Gardens
Thalictrum petaloideum	Meadow rue	1-2′	Pinkish white	June-July	Asia
Trollius europaeus	Globe flower	8-12″	Yellow or white	Apr.-May	Europe
Vinca minor	Common periwinkle	Trailing	Blue	May	Europe
Viola odorata	Sweet violet	4-6″	Blue	Spring and autumn	Europe, Africa, Asia

XII. BULBOUS PLANTS

	Botanical name	Common name	Approx. height	Color of flowers	Approx. time of bloom	Habitat
*BL	*Chionodoxa Allenii*	Allen's glory-of-the-snow	3-6″	Blue	Mar.-Apr.	Gardens
BL	*Chionodoxa Luciliae*	Glory-of-the-snow	3-6″	Blue	Mar.-Apr.	Asia Minor
BL	*Chionodoxa Luciliae* var. *alba*	White glory-of-the-snow	3-6″	White	Mar.-Apr.	Asia Minor
BL	*Chionodoxa Luciliae* var. *gigantea*	Giant glory-of-the-snow	4-8″	Blue	Mar.-Apr.	Gardens

	Botanical name	Common name	Approx. height	Color of flowers	Approx. time of bloom	Habitat
BN	*Colchium autumnale*	Meadow saffron	2-4"	Purple, white striped	Sept.-Oct.	Europe
BN	*Colchium sativus*	Saffron crocus	6"	Lilac	Sept.-Oct.	Europe, Asia Minor
BN	*Colchium speciosum*	Meadow saffron	6-12"	Violet to pink	Sept.-Oct.	Caucasus
BN	*Colchium variegatum*	Meadow saffron	3-6"	Rosy purple	Sept.	Asia Minor
L	*Crocus biflorus*	Scotch crocus	6-8"	Cream	March	Southern Europe
BN	*Crocus speciosus*	Autumn crocus	6-8"	Lilac	Sept.-Oct.	Europe, Asia Minor
L	*Crocus susianus*	Cloth of gold	3"	Yellow, striped brown	March	Crimea
L	*Crocus vernus*	Common garden crocus	4-5"	White or lilac	March	Europe
B	*Fritillaria atro-purpurea*	Purple fritillary	12-15"	Deep purple	Apr.-May.	
B	*Fritillaria aurea*	Golden fritillary	6-12"	Bright yellow	Apr.-May.	Caucasus
B	*Fritillaria Imperialis*	Crown Imperial	2-3'	Orange	April	
B	*Fritillaria meleagris*	Guinea-hen flower	10-12"	Green, white, purple	April	Caucasus

*The letters preceding the names indicate the following: B, suitable for borders; L, suitable for naturalizing in lawns; N, suitable for naturalizing in shrubberies and in places where the grass need not be cut until the foliage of the bulbous plants mature, such as fields and meadows. A combination of these letters indicate that the plant is adapted to more than one of the above situations.

	Botanical name	Common name	Approx. height	Color of flowers	Approx. time of bloom	Habitat
B	*Fritillaria pallidiflora*	Pale fritillary	6-15"	Greenish-yellow	Apr.-May.	Siberia
NL	*Galanthus Elwesii*	Giant snowdrop	6-12"	White	Mar.-Apr.	Asia Minor
NL	*Galanthus nivalis*	Common snowdrop	4-6"	White	Feb.-Mar.	Caucasus
NL	*Galanthus plicatus*	Plaited snowdrop	4-8"	White	March	Crimea
B	*Hyacinthus orientalis* and varieties	Garden hyacinth.	8-18"	Various colors.	Mar.-Apr.	Europe
NB	*Leucojum aestivum*	Summer snowflake	12"	White	Apr.-May.	Europe
NB	*Leucojum vernum*	Spring snowflake.	6-12"	White	Mar.-Apr.	Europe
NB	*Lilium tigrinum*	Tiger lily	3-4'	Orange	June-July.	China
NL	*Muscari botryoides*	Grape hyacinth.	6-9"	Blue	March	Europe to Orient
NL	*Muscari botryoides* var. *album*	White grape hyacinth	9"	White	March	Europe
NL	*Muscari commutatum*	Purple grape hyacinth	6-10"	Dark blue	March	Mediterranean region
BN	*Narcissus biflorus*	Primrose peerless	1-2'	White	Apr.-May.	Europe
BN	*Narcissus Burbidgei*	Burbidge's narcissus	12-15"	White	Apr.-May.	Europe
BN	*Narcissus incomparabilis* and varieties	Star daffodil	12-15"	Yellow	Apr.-May.	Europe

	Botanical name	Common name	Approx. height	Color of flowers	Approx. time of bloom	Habitat
BN	*Narcissus Jonquilla* and varieties.	Jonquil	8-15"	Yellow	Apr.-May.	Europe, Algeria
BN	*Narcissus poeticus* and varieties.	Poet's narcissus.	12-15"	White	Apr.-May.	Mediterranean region
BN	*Narcissus Pseudo-Narcissus*	Trumpet daffodil.	12-18"	Yellow	Apr.-May.	Europe
BN	*Ornithogalum umbellatum*	Star of Bethlehem	6"	White	Apr.-May.	Mediterranean region
BN	*Ornithogalum nutans*	Star of Bethlehem	8-12"	White and green	April	Europe
LBN	*Scilla amoena*	Star hyacinth	6-9"	Blue	March	Tyrol
LBN	*Scilla bifolia*	Early squill	4-6"	Blue	March	Europe, Asia Minor
BN	*Scilla festalis*	Wood hyacinth	8-12"	Various colors	Apr.-May.	Europe
BN	*Scilla festalis* var. *alba*	White wood hyacinth	8-12"	White	Apr.-May.	Europe
BN	*Scilla festalis* var. *cernua*	Nodding wood hyacinth	8-12"	Purple-pink	Apr.-May.	Portugal
BN	*Scilla hispanica*	Bell-flowered squill	12-18"	Various colors	Apr.-May.	Portugal
BN	*Scilla hispanica* var. *alba*	White Spanish squill	12-18"	White	Apr.-May.	Europe
BNL	*Scilla sibirica*	Siberian squill	2-6"	Blue	March	Europe, Asia Minor

	Botanical name	Common name	Approx. height	Color of flowers	Approx. time of bloom	Habitat
LBN	*Scilla sibirica* var. *alba*.....	White Siberian squill	3-6".....	White.....	Feb.-April	Gardens
B	*Tritonia crocosmaeflora* and varieties	Montbretia	2-3'.....	Yellow and orange..	June-July.	Gardens
B	*Tulipa*, species and varieties.	Garden tulips.....		Various colors..	Mar.-May..	Oriental countries

NOTES

The October number of Parks and Recreation contains an article by Mr. L. P. Jensen, Arboriculturist to the Garden, on "The Value of Parks to Posterity."

On October 19 Mr. John H. Kellogg, of the Missouri Botanical Garden, spoke before the St. Louis Natural History Museum Association at the St. Louis Public Library on "Fall Flowers."

Mr. L. P. Jensen, Arboriculturist to the Garden, gave an illustrated lecture on "Our Native Plants: Their Conservation and Uses," September 23, before the Parent-Teachers' Association of the Lockwood School, Webster Groves.

The following lectures were delivered by Mr. G. H. Pring, Horticulturist to the Garden, during his recent trip to New York where he attended the convention of the National Association of Gardeners: "The School Garden Movement of Cleveland, Ohio," before the National Association of Gardeners, October 11; "Gardening in the Western States compared with that of the Eastern States," before the Garden Club of Flushing, New York, October 10; "Commercial Gardening in the Middle West," before the New York Florists' Club, October 10.

On Sunday, November 6, the annual chrysanthemum show in the floral display house at the Garden will be open to the public. Over 3,000 plants will be exhibited including single-stemmed, bush, and basket forms. Some of the fea-

tures of the 1921 display will be an exhibit of Japanese oddities, the pink "Turner," which is one of the latest novelties, and the grafted varieties showing different-colored flowers on the same plant.

Recent visitors to the Garden include Professor N. I. Vavilov, of the Bureau of Applied Botany and Plant Breeding, Petrograd, Russia, and Professor A. Jaczewski, Director of the Institute of Mycology and Phytopathology, Petrograd, who are visiting America at the invitation of the American Phytopathological Society; and Dr. R. W. Webb, formerly Rufus J. Lackland fellow at the Garden, now scientific assistant, Department of Plant Pathology, United States Department of Agriculture, Madison, Wisconsin.

STATISTICAL INFORMATION FOR SEPTEMBER, 1921

GARDEN ATTENDANCE:	
Total number of visitors	21,900
PLANT ACCESSIONS:	
Total number of plants received in exchange	3
Total number of plants and seeds received as gifts	7
LIBRARY ACCESSIONS:	
Total number of books and pamphlets bought	53
Total number of books and pamphlets donated	444
HERBARIUM ACCESSIONS:	
By Gift—	
Bisby, Prof. G. R.—Fungi of Manitoba	26
Blackford, Mrs. E. B.—*Tremellodendron candidum* from New Hampshire	1
Drushel, J. A.—Plants of Vermont, New York, Ohio, Missouri, Texas, and Colorado	32
Hartley, Dr. Carl—Timber-destroying fungi of Java	18
Lloyd, C. G.—Fungi of the Philippine Islands and Japan	2
Miyabe, Prof. K.—*Valsa Mali* Miyabe & Yamada of Japan	2
Murrill, Dr. W. A.—*Stereum petalodes* from Cuba	1
Overholts, Dr. L. O.—*Cyphella conglobata* Burt	1
Povah, Prof. A. H. W.—Fungi of Alabama	4
Rosen, H. R.—*Cercospora Setariae* Atk.	1
Wakefield, E. M.—Fungi	2
By Purchase—	
Dusen, P.—Plants of Brazil	457
By Exchange—	
New York Botanical Garden—*Isoetes* sp. from British Guiana	1
Total	548

The Garden is open to the public every day in the year, except New Year's, Fourth of July, Labor Day, and Christmas—week days from 8:00 A. M. until one-half hour after sunset; Sundays from December to April, 1:00 P. M. until sunset, from April to December, 2:00 P. M. until sunset.

The main entrance to the Garden is located at Tower Grove Avenue and Flora Boulevard, on the Vandeventer Avenue car line. Transfer south from all intersecting lines.

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MISSOURI BOTANICAL GARDEN BULLETIN

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COTTON PLANTS IN THE ECONOMIC GARDEN.

Missouri Botanical Garden Bulletin

Vol. IX St. Louis, Mo., November, 1921 No. 9

COTTON

Although a considerable amount of cotton is grown in Missouri, its culture is confined chiefly to the southeastern section of the state which has a longer growing season than this locality. The length of time required to bring a crop of cotton to maturity depends upon various factors, chief among them being the kind of cotton and the temperature. At least six months is required to mature cotton in St. Louis, and the plants grown in the economic garden at the Garden were started indoors in order to insure their ripening before frost.

Only the herbaceous or shrub-like forms of cotton are grown in this country. In the southern states the much-branched cotton plant attains a height of about four feet. The flowers are yellow and as they age turn to a deep rose. The boll gradually swells until it attains the size of a walnut and at maturity splits, exposing the several cells which hold the numerous seeds with their copious covering of fibers known as lint. This lint becomes the cotton of commerce after passing through various stages of manufacture.

To the naked eye a cotton fiber is round and smooth, but upon examining it under a microscope it will be found to be very much twisted—a characteristic which adapts it so readily to spinning, no other vegetable or animal fiber possessing this peculiar twist. These hairs are the result of the elongation of certain epidermal cells of the seed coats. Immature cotton does not have the proper number of twists and it also lacks strength and is slow to take dye. Not all of the fibers are of the same length, and while mature seed is clothed in many long hairs a fuzz is also present. That cotton may qualify for the highest market value it is essential that the floss be as near one length as possible and mature uniformly. The floss of mature cotton assumes certain tints depending upon

the presence of minute colored particles in the central core. In the wild cotton these particles impart a red color and when such cotton occurs among the cultivated species it is a sign of reversion or of a very low grade. The cotton fiber is covered with a sort of varnish known as cotton wax. This substance prevents the fiber from absorbing moisture and in absorbent cotton is removed by chemical action.

Cotton seed is planted in rows three to four feet apart and appears above the ground in about ten days. When the plants are well established they are thinned or chopped out until they are from one to two or more feet apart. The crop is constantly cultivated until midsummer or until the bolls begin to open, the aim for the first eighty days being to secure a good healthy growth. After abundant fruiting has begun, it is undesirable to have the growth proceed so rapidly. When a sufficient number of bolls are open, picking commences and lasts until the plants are killed by frost or until all the cotton is picked. Cotton should be picked as fast as it ripens and before it can be damaged by rain, wind, or dust. As a rule, cotton fields are picked over three times, generally in September, October, and November. Picking is done by hand, the cotton being placed in bags and these emptied into baskets or on to sheets. Cotton-picking machines have been tried occasionally, but up to the present none have been very successful. Of all the cotton picked only one-third of the material by weight is cotton fiber, the remaining two-thirds being seed.

Although cotton is perennial in some climates it is usually treated as an annual. A considerable quantity of cotton is produced in the following countries: Australia, Brazil, China, Egypt, India, Italy, Mexico, South Africa, South Sea Islands, and Turkey. In this country the cotton states are Alabama, Arkansas, Florida, Georgia, Louisiana, Missouri, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, and Texas. There are also areas in Arizona, Kentucky, Nevada, New Mexico, southern California, and Utah suitable for cotton culture, or in which the culture has developed to a slight extent. The cotton belt of the United States, on account of its climate, soil, labor, capital, and transportation facilities, is the most favorable place in the world for growing the crop.

Cotton is probably used by more people and in more ways than any other fiber. It has long been known in many countries, but its original habitat is not definitely determined. It was probably in use in India long before the Christian era,

and its culture gradually spread to China, Japan, and other countries. Many of the early writers frequently made mention of cotton, and it is said that the material wrapped about the mummies found in Peruvian tombs was from this fiber. The cloth with which the Egyptians covered their dead appears to be linen, but cotton was probably known in Egypt from early times. India was the center of the cotton industry for a long time, and the natives not only manufactured sufficient cloth for their own needs but sold it to traders from other countries. In China the use of cotton for clothing made little progress until about the thirteenth century, silk being the material in common use. Of Egypt, Pliny says: "In upper Egypt, toward Arabia, there grows a shrub which some call 'gossypion' and others 'xylon,' from which the stuffs are made which we call 'xylina.' It is small and bears a fruit resembling the filbert, within which is a downy wool which is spun into thread. Nothing is more to be desired than this goods for whiteness and softness. Garments are made from it which are very acceptable to the priests of Egypt."

When Columbus first came to this continent he found cotton growing abundantly in the West Indies and being used to a considerable extent for clothing on the mainland. The Mexicans used cotton exclusively for clothing and it was also found in Peru and Brazil.

Although cotton was grown and spun into cloth by the ancients, it was slow in gaining popularity in Europe. It was used in Italy at the beginning of the fourteenth century, and its manufacture was confined to southern Europe until the sixteenth century. In England, for a long time, the machinery for spinning was crude and fine yarn could not be made, and it is not known when cotton was first manufactured in that country. About the middle of the eighteenth century England began to export her cotton goods, and the demand soon increased to such an extent that it became a problem to obtain sufficient raw materials and adequate machinery to supply her trade. At this time Arkwright, Cartwright, Crompton, Hargreaves, Kay, and Watt invented machines which aided cotton manufacture. The raw material at that time came principally from the West Indies, the Levant, and India. The United States was producing very little, Brazil being practically the only American country supplying raw cotton. From a non-producing cotton country the United States has sprung into the lead in cotton growing. Bancroft

in his "History of the United States," says: "The first culture of cotton in the United States deserves commemoration. In this year (1621) the seeds were planted as an experiment and their 'plentiful coming up' was at that early day a subject of interest in America and England." The cotton industry has now grown to such an extent in this country that the United States is the barometer in the cotton world.

The generic name given to the cotton plant by Linnaeus is Gossypium, and it belongs to the Malvaceae, or mallow family, which also includes such common plants as the hollyhock and hibiscus. On account of their great variability and the tendency to hybridize, the species of this genus are difficult to classify. Many attempts have been made but no two authorities agree. Those varieties of more or less economic importance are the Oriental tree cotton (*G. arboreum* Linn.), sea-island cotton (*G. barbadense* Linn.), tropical tree cotton of South America (*G. brasiliense* Macf.), upland cotton (*G. herbaceum* Linn.), and Indian cotton (*G. neglectum* Todaro.)

Oriental Tree Cotton.—The original habitat of this species is doubtful. The plant is perennial, lasting from five to six years and attaining a height of twenty feet. The flowers are purple and have a large darker patch at the base. It is not grown commercially at the present time and is said to be found usually near temples where it blooms most of the year. According to Indian tradition the fiber of this species was used by the Egyptian priests to make their robes, and it is probably on that account that it is sometimes known as *G. religiosum.*

Sea Island Cotton.—Sea island cotton is valued for the length and quality of the fiber, but is not grown extensively. The amount of lint from this cotton is less than that from any other kind grown in this country, but its high market value compensates for the small yield. Sea island cotton was probably first grown in Georgia in the latter part of the eighteenth century from seed obtained from the Bahamas. This cotton differs materially from *G. herbaceum,* which furnishes the upland cotton, in its seed characteristics. The seed of the sea island cotton is small and black and the lint separates readily, while that of the upland cotton is green and is surrounded by a short dense fuzz beneath the longer and more valuable lint. The flowers are creamy yellow with a purple spot at the base of the petals. The lint is from 1½ to 2½ inches in

length. Sea island cotton flourishes along the coasts of South Carolina, Georgia, Florida, and in Egypt, the Egyptian cotton having been developed from American seed. Sea island cotton gives the finest fiber of any species and is much used for the better fabrics and in the manufacture of automobile tires. Its production is limited by soil and climatic conditions.

Tropical Tree Cotton of South America.—This cotton is indigenous to South America. It was known in commercial circles about the middle of the seventeenth century, but was even then confused by botanists. This species attracted much attention in Europe because it was thought that the heavily covered seeds, which are produced in large numbers, would yield a large and profitable amount of cotton. Its culture spread throughout the world, but to-day it is the least popular of the cultivated cottons. It is said that South American cotton was in great demand in Scotland and England prior to the discovery of the upland and sea island varieties of the United States, but it is not probable that it will ever regain its lost popularity.

Upland Cotton.—Some botanists claim that *G. hirsutum* is only a variety of *G. herbaceum,* the former being considered of American origin, while the latter comes from Asia. The plants grow to a height of about six feet and bear yellowish flowers which turn red with age. The lint of the upland cotton seldom exceeds 1½ inches in length and much of it is shorter. The upland varieties of cotton do not furnish as fine a quality of fiber as the sea island cotton, but are grown over a wider territory.

Although cotton has been grown for fiber for centuries in various countries, it was the Americans who discovered many other properties of the plant. The inferior and short lint is used in the manufacture of cotton batting, wadding, and absorbent cotton, for stuffing material in pads, cushions, mattresses, and upholstery. When mixed with wool it is used in hat making and mixed with lambs' wool for fleece-lined underwear and felt. Candle and lamp wicks, twine, rope, and carpets are made from low-grade yarns. As the cotton fiber is composed almost entirely of cellulose, it is used in the manufacture of writing-paper, gun-cotton, smokeless powder, celluloid, and photographic films. The seed hulls and meat serve as feed and fertilizer. The oil which is expressed from the seeds is used in many ways, among them being lard sub-

stitutes, olive-oil adulterant, salad oils, oleomargarine, and as medicine.

RICE

The growing season in St. Louis is too short to bring rice to maturity, and on that account the plants for the economic garden are started indoors the latter part of March. The bed in which the plants are set as soon as the weather permits is about three inches below the surrounding soil. This permits soaking the bed several times a week in dry weather, but due to the location the rice bed is never flooded as in the rice-growing sections. The plants at the Garden grow vigorously, but do not head until about the middle of September. In the fall of 1920 the seed barely matured when one heavy frost stopped further growth. The following morning sufficient seed for the next year's crop was gathered, although it was doubtful whether it would germinate after this freeze. Apparently the frost did not affect the seed, however, as in March the percentage of germination was very high. As a killing frost came very late this fall, November 9, the rice had ample time to ripen fully.

Rice is first mentioned in early Chinese history where a ceremony was established about 2800 B.C., in which five kinds of grain were sown, one of them being rice. Subsequently it was grown in India, and there is little doubt but that it was native there. Rice probably was cultivated in China 3000 B. C., and from there its culture spread to India, Persia, Asia, Arabia, Egypt, and Europe. In some parts of the Orient rice is still used as the medium of exchange to pay debts, taxes, etc.

The number of species of rice are doubtful and by some botanists they are only considered varieties of the one species, *Oryza sativa* Linn., which belongs to the grass family (Gramineae). There are many varieties under cultivation, differing in quality, yield, color, size and shape of the kernel, food value, flavor, and length of time required for maturity. Rice is a crop that thrives only in a damp tropical or semi-tropical climate, and on that account it is grown in those localities that are assured of an abundance of moisture.

Rice is grown very extensively and is one of the most important foodstuffs of the world. In the oriental countries, especially China, Japan, and India, it forms a large part of the diet of the people. The Orient produces about ninety-

RICE PLANTS IN THE ECONOMIC GARDEN.

seven per cent of the world's crop, but the United States now grows enough to supply its own needs. The industry in this country commenced about the middle of the seventeenth century. The first attempt in growing rice in Virginia was a failure, the first successful crop in this country having been raised in South Carolina. In 1694 a vessel bound from Madagascar to Liverpool met with an accident in a storm and was blown far from her course. She put in at Charleston, S. C., and among those who boarded the vessel was Thomas Smith who secured a package of seed from the captain of the vessel. This he planted and the resultant crop was almost sufficient for the needs of the colony. From that time the rice industry in the United States became permanent. Before the Civil War, Georgia and the Carolinas were practically the only states growing rice in any considerable quantity, but after the war other states took up rice culture, especially Louisiana and Texas.

The two varieties grown along the Atlantic coast and considered among the best of the world are the Carolina Gold and Carolina White. The principal varieties grown in Louisiana are the Honduras and several Japanese varieties. In the United States the greater part of the rice is grown on the tide-water lands and reclaimed cypress swamps of the South. Rice is planted in three ways: by sowing broadcast, by drill, or by transplanting. As soon as the plants are up the water is applied to the fields and gradually increased as growth permits. After the water has reached a depth sufficient to kill the weeds it is withdrawn and the crop cultivated when the soil is workable. The field is again flooded and the water allowed to remain until the crop is nearly mature. In some instances water is applied to the fields immediately after sowing the seed and is allowed to remain for a few days when it is withdrawn to permit germination.

Rice is now harvested and thrashed in much the same way as wheat, most of the land becoming sufficiently firm after drawing off the water to bear the machines. The thrashed grain is known as rough rice or paddy. In milling, the hulls, bran, and the germ are removed.

Unpolished or brown rice is more nutritious and has a better flavor than polished rice. However, in this country the market demands polished grains which keep much better, the brown kind becoming rancid in warm weather. Rice is graded according to the size and percentage of unbroken kernels, but

the food value is practically constant in the different grades. The grains are whitened by a coating of glucose and talc, practically all of which is removed if the rice is thoroughly washed before cooking. Rice is very nutritious despite the fact that part of the protein, fat, and mineral matter is removed in milling. If polished rice were continually used as the principal article of food, a disease known as "beriberi" would develop due to the lack of certain vitamines, but when the diet contains a variety of foods, no harm will result.

Like cotton, rice has several by-products. In China and Japan rice straw is used for making brooms, hats, matting, paper, sandals, and other articles. In this country the straw has been used for stock food, but this industry is usually not developed in rice-growing sections. The hulls are used for fuel, packing material, and sometimes as a fertilizer. Fresh bran makes excellent cattle food.

UNUSUAL LATE-FLOWERING PERIOD OF PLANTS

The dry summer of 1921 followed by a rainy and mild period in September and October caused an unusually late blooming season for plants in this vicinity. Some plants which ordinarily flower in March and April started in on a second period of bloom, and, due to the long season, many fall-blooming plants have been blooming vigorously for several months. Following is a list of the plants growing out of doors at the Garden which were recorded as blooming as late as November 9:

Botanical name	Common name	Usual season of bloom
Achillea Millefolium var. *rubrum*	Yarrow	May to June
Achillea Ptarmica		May to June
Actinomeris alternifolia	Actinomeris	Aug. to Sept.
Ageratum conyoides	Ageratum	May to frost
Aquilegia californica	California columbine	May
Argemone mexicana	Prickly poppy	July to Aug.
Aster ericoides	White heath aster	Sept. to frost
Aster multiflorus	White heath aster	Sept. to Oct.
Aster novae-angliae	New England aster	Sept. to Oct.
Aster novae-angliae var. *rubra*	New England aster	Sept. to Oct.
Aster oblongifolius	Aromatic aster	Sept. to Oct.
Aster sagittifolius	Arrow-leaved aster	Sept. to Oct.
Aster salicifolius	Willow-leaf aster	Sept. to Oct.
Aster tataricus	Tartarian aster	Oct. to frost
Aster turbinellus	Prairie aster	Sept. to frost

Botanical name	Common name	Usual season of bloom
Borago officinalis	Borage	May-June
Buddleia variabilis	Buddleia	Aug. to frost
Buddleia Wilsonii	Buddleia	Aug. to frost
Cardiospermum Halicacabum	Balloon vine	June to frost
Celosia species	Cockscomb	June to frost
Ceratostigma plumbaginoides	Plumbago	Aug. to Sept.
Chrysanthemum, hardy garden varieties	Chrysanthemum	Oct. to frost
Chrysanthemum Leucanthemum	Shasta daisy	May to June
Cichorium Intybus	Chicory	May to frost
Cleome spinosa	Spider flower	June to frost
Commelina communis	Day-flower	May to frost
Cornus Baileyi	Dogwood	May
Cosmos bipinnatus	Cosmos	Sept. to frost
Dahlia variabilis	Dahlia	Sept. to frost
Delphinium chinense	Larkspur	May to June
Delphinium formosum	Larkspur	May to June
Diamorpha sp	African daisy	May to frost
Dianthus plumarius	Garden pink	April to May
Dicentra eximia	Wild bleeding heart	April to frost
Diervilla hybrida	Weigelia	May
Echinacea purpurea	Purple cone-flower	July to Aug.
Encelia helianthoides	Encelia	Aug. to frost
Eschscholtzia californica	California poppy	June to frost
Eupatorium coelestinum	Mist-flower	Sept. to Oct.
Forsythia intermedia	Golden bell	March to April
Gaillardia grandiflora	Gaillardia	June to frost
Galinsoga parviflora	Galinsoga	June to frost
Geranium sanguineum	Hardy geranium	May to frost
Gomphrena globosa	Globe amaranth	June to frost
Hamamelis virginiana	Witch hazel	Oct. to Nov.
Helianthus angustifolius	Narrow-leaved sunflower	Sept. to frost
Heliopsis scabra	Heliopsis	June to Sept.
Heliotropium anchusaefolium	Heliotrope	July to frost
Heliotropium corymbosum	Garden heliotrope	July to frost
Hyssopus officinalis	Hyssop	June to July
Iberis sempervirens	Rock cress	April
Ipomoea purpurea	Morning-glory	May to frost
Kerria japonica	Kerria	May to Sept.
Kochia scoparia	Kochia	Sept. to frost
Linaria sp		Aug. to Sept.
Linum perenne	Flax	April to May
Lippia citriodora	Lemon verbena	May to frost
Lonicera fragrantissima	Fragrant honeysuckle	March to April
Mirabilis Jalapa	Four-o'clock	June to frost
Myosotis palustris	Forget-me-not	May to June
Nepeta melissaefolia		May to frost
Nicotiana affinis	Flowering tobacco	May to frost
Oenothera biennis	Evening primrose	June to frost
Oxalis stricta	Oxalis	April to frost

Botanical name	Common name	Usual season of bloom
Pentstemon barbatus	Pentstemon	May to June
Pentstemon barbatus var. *Torreyi*		May to June
Petunia hybrida	Garden petunia	May to frost
Phaseolus multiflorus	Scarlet runner bean	June to frost
Phlox paniculata	Hardy garden phlox	June to frost
Phlox subulata	Moss pink	April to May
Physocarpus sp		May to June
Polygonum baldschuanicum	Climbing polygonum	Sept. to frost
Polygonum hydropiperoides	Water pepper	Aug. to Oct.
Pyrethrum coccineum	Pyrethrum	May
Rosa hybrids	Garden varieties of roses	June to frost
Rudbeckia fulgida	Orange cone-flower	Aug. to Oct.
Rudbeckia laciniata	Tall cone-flower	Aug. to Sept.
Rudbeckia speciosa	Showy cone-flower	Sept. to frost
Salvia azurea	Hardy salvia	July to Aug.
Salvia splendens	Scarlet sage	July to frost
Saponaria officinalis	Bouncing Bet	June to Sept.
Sedum Maximowiczii	Live-forever	July
Sedum spectabile	Sedum	Sept. to Oct.
Sida Elliottii	Sida	July to frost
Solidago latifolia	Golden-rod	Sept. to Oct.
Solidago nemoralis	Golden-rod	Sept. to Oct.
Solidago petiolaris	Golden-rod	Oct. to Nov.
Spiraea Billiardii	Spiraea	July to Aug.
Spiraea Bumalda var. "Anthony Waterer"	Spiraea	May to Sept.
Spiraea Douglasii	Spiraea	July to Aug.
Spiraea Menziesii	Spiraea	July to Aug.
Spiraea salicifolia × *Douglasii*	Spiraea	July to Aug.
Stokesia cyanea	Stokes' aster	May to July
Tagetes erecta	African marigold	June to frost
Tanacetum vulgare	Tansy	June to Aug.
Taraxacum officinale	Dandelion	March to Dec.
Verbena canadensis	Large-flowered verbena	May to frost
Verbena hybrida	Garden verbena	May to frost
Verbena tenera	Verbena	May to frost
Veronica spicata	Speedwell	May to June
Vicia villosa	Hairy vetch	June to frost
Vinca major	Vinca	June to frost
Zinnia elegans	Garden zinnia	June to frost

HARDY EXOTIC PLANTS SUITABLE FOR THE GARDENS OF MISSOURI AND ADJOINING STATES

(Continued from October Bulletin)

XIII. ORNAMENTAL GRASSES

Botanical name	Common name	Approx. height	Color of foliage	Approx. time of bloom	Habitat
Arrhenatherum bulbosum	Variegated oat grass	6-8′	Green, striped white	July-Aug.	Gardens
Arundinaria japonica	Japanese bamboo	6-10′	Green	July-Aug.	Japan
Arundo Donax	Giant reed	10-15′	Reddish	Aug.-Sept.	Europe
Arundo Donax var. *variegata*	Giant reed	10-15′	Variegated	Aug.-Sept.	Gardens
Dactylis glomerata var. *variegata*	Variegated orchard grass	1½-2′	Green, silvery markings	August	Gardens
Elymus arenarius	Sea lyme-grass	2-5′	Green	August	Temperate zone
Erianthus Ravennae	Plume-grass	4-7′	Greenish	August	Europe
Festuca glauca	Blue fescue grass	18-20″	Greenish	June-July	Europe
Miscanthus sinensis and varieties	Eulalia	4-9′	Brownish violet	October	Japan
Molinia caerulea var. *variegata*	Variegated hair grass	1-2′	Purple with yellow stripes	May-June	Europe, Asia
Scirpus Holoschoenus var. *variegatus*	Variegated sedge	1-1½′	Brown, stems banded with green and yellowish white	June-July	Gardens
Stipa pennata	Feather-grass	2-3′	Green	July-Aug.	Europe, Siberia

XIV. TREES FOR STREET AND AVENUE PLANTING

Botanical name	Common name	Habitat
Acer platanoides	Norway maple	Europe, Caucasus
Acer pseudoplatanus	Sycamore maple	Europe, Caucasus

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Botanical name	Common name	Habitat
Ailanthus glandulosa	Tree of heaven	Asia
Fraxinus excelsior	European ash	Europe, Orient
Fraxinus Ornus	Ash	Europe, Asia
Ginkgo biloba	Maidenhair tree	China
Magnolia Kobus	Magnolia	Japan
Phellodendron amurense	Chinese cork tree	China, Japan
Platanus orientalis	Oriental sycamore	Europe, India
Platanus orientalis var. *acerifolia*	Maple-leaved sycamore	Gardens
Populus alba	White poplar	Europe, Asia
Populus alba var. *Bolleana*	Bolle's poplar	Turkestan
Populus nigra var. *italica*	Lombardy poplar	Asia
Quercus Cerris	Turkey oak	Europe, Asia
Quercus pedunculata	English oak	Europe, Africa
Ulmus montana	Scotch elm	Europe, Japan

All the trees mentioned above will endure ordinary city conditions except Acer and Quercus. The Ailanthus will do well under the most unfavorable city conditions and is desirable only for such cases.

XV. TREES AND SHRUBS FOR UNFAVORABLE AND SMOKY CITY CONDITIONS

Botanical name	Common name	Habitat
TREES SUITABLE FOR A VERY SMOKY ATMOSPHERE*		
Broussonetia papyrifera	Paper mulberry	China, Japan
Koelreuteria paniculata	Varnish tree	China, Japan
Magnolia Yulan	Magnolia	China, Japan
Morus alba	White mulberry	Asia
TREES SUITABLE FOR LESS SMOKY CONDITIONS		
Acer campestre	English cork maple	Europe, Asia
Aesculus Hippocastanum and varieties	European horse-chestnut	Europe
Aralia chinensis	Chinese angelica tree	China, Japan
Cercidiphyllum japonicum	Cercidiphyllum	Japan
Crataegus Oxyacantha	English hawthorn	Europe, Africa
Evonymus species		Europe, Japan
Salix babylonica and varieties	Weeping willow	Caucasus
Salix Caprea	Pussy willow	Europe, Asia
Ulmus campestris	English elm	Europe
Zelkova acuminata	Zelkova	Japan

*Those mentioned for "Street and Avenue Planting" are also suitable for smoky city conditions.

Botanical name	Common name	Habitat
SHRUBS SUITABLE FOR A VERY SMOKY ATMOSPHERE		
Acanthopanax pentaphyllus	Aralia	Japan
Diervilla species	Weigelia	Japan, China
Forsythia species	Golden-bell	China
Hibiscus syriacus and varieties	Althaea	Asia
Ligustrum species	Privet	Europe, Orient
Magnolia species	Magnolia	China, Japan
Philadelphus species	Mock-orange	Europe, Japan
Tamarix species	Tamarix	Europe, Japan
Viburnum species	Viburnum	Europe, Asia
SHRUBS SUITABLE FOR LESS SMOKY CONDITIONS		
Cercis chinensis	Chinese redbud	China
Colutea arborescens	Bladder senna	Europe, Africa
Cornus alba	Red-branched dogwood	Siberia, China
Cornus mas	Cornelian cherry	Europe, Orient
Cornus sanguinea	Dogwood	Europe, Orient
Deutzia scabra	Deutzia	China, Japan
Elaeagnus longipes	Japanese oleaster	China, Japan
Evonymus species		Europe, Japan
Exochorda grandiflora	Pearl-bush	Turkestan
Lonicera species	Bush honeysuckle	Manchuria
Rhodotypos kerrioides	White kerria	Japan
Rhus Cotinus	Smoke tree	Europe, Asia
Sambucus nigra	European elder	Europe
Securinega ramiflora	Securinega	Asia
Spiraea species	Spiraea	Temperate regions
Syringa species	Lilac	Europe, Asia
Vitex Agnus-castus	Chaste-tree	Europe, Asia

XVI. TREES AND SHRUBS WITH BRIGHT-COLORED FOLIAGE IN AUTUMN AND CONSPICUOUS FRUIT AND BARK IN AUTUMN AND WINTER

Botanical name	Common name	Color of foliage	Color of fruit	Color of bark
TREES.				
Acer campestre	English cork maple	Yellow		
Acer ginnala	Maple	Scarlet		
Acer platanoides	Norway maple	Pale yellow		
Acer platanoides var. *Schwedleri*	Schwedler's maple	Purplish		
Acer pseudoplatanus	Sycamore maple	Yellow		
Acer tataricum	Tartarian maple	Reddish		
Alnus incana	Speckled alder		Green, turning black	

Botanical name	Common name	Color of foliage	Color of fruit	Color of bark
Betula alba and varieties	White birch			White
Evonymus Bungeana	Bunge's spindle tree		Orange and scarlet	
Evonymus europaeus	European spindle tree		Orange and scarlet	
Fagus sylvatica var. *purpurea*	Purple beech	Purple all season		
Fraxinus excelsior	European ash	Bronze		
Ginkgo biloba	Maidenhair tree	Yellow		
Juglans Sieboldiana	Japanese walnut	Yellow		
Phellodendron amurense	Chinese cork tree			Black
Platanus orientalis	Oriental sycamore			Gray
Populus alba	White poplar	Grayish		Gray
Salix Caprea	Pussy willow	Grayish	Silvery gray	Gray
Salix species	Willow	Bright green		

SHRUBS.

Berberis ilicifolia	Holly-leaved barberry	Bronze	Bright red	
Berberis Thunbergii	Thunberg's barberry	Scarlet and yellow	Bright red	
Berberis vulgaris var. *purpurea*	Purple barberry	Purple	Red	
Cornus alba	Red-branched dogwood			Red
Cornus sanguinea	Red-branched dogwood			Dark red
Corylus Avellana var. *atropurpurea*	Purple hazel	Purple all season		
Cotoneaster acuminata	Cotoneaster		Reddish purple	
Cotoneaster multiflora	Cotoneaster		Scarlet	
Crataegus Oxyacantha	English hawthorn	Reddish	Red	
Elaeagnus longipes	Japanese oleaster	Silvery all season	Red	Silvery
Elaeagnus umbellata	Oleaster	Silvery all season	Red	
Evonymus alata	Strawberry bush	Pinkish red	Red and orange	
Forsythia species	Golden-bell			Bright green
Hippophae rhamnoides	Sea buckthorn	Silvery all season	Red	Silvery

Botanical name	Common name	Color of foliage	Color of fruit	Color of bark
Kerria japonica	Kerria			Bright green
Ligustrum species		Glossy green		
Rhamnus cathartica	Buckthorn			Black
Rhus Cotinus	Smoke tree			Grayish green
Sambucus nigra	European elder	Yellow		
Securinega ramiflora	Securinega	Yellow	Green	Grayish green
Staphylea colchica	Bladder-nut			Grayish white
Viburnum Carlesii	Viburnum	Reddish		
Viburnum Lantana	Viburnum	Reddish	Green, red, black	
Viburnum Sieboldii	Viburnum	Reddish	Bright red	

XVII. TREES ARRANGED ACCORDING TO FORM OF OUTLINE

Botanical name	Common name
LARGE TREES OF FORMAL OUTLINE	
Acer platanoides	Norway maple
Acer platanoides var. *Schwedleri*	Schwedler's maple
Acer pseudoplatanus	Sycamore maple
Aesculus Hippocastanum	European horse-chestnut
Aesculus Hippocastanum var. *flore pleno*	European horse-chestnut
Aesculus Hippocastanum var. *rubicunda*	Red-flowering horse-chestnut
Castanea sativa	European chestnut
Cercidiphyllum japonicum	Cercidiphyllum
Fagus sylvatica	European beech
Fagus sylvatica var. *purpurea*	Purple beech
Fraxinus excelsior	European ash
Fraxinus Ornus	Ash
Magnolia Kobus	Magnolia
Magnolia Yulan	Magnolia
Phellodendron amurense	Chinese cork tree
Platanus orientalis	Oriental sycamore
Platanus orientalis var. *acerifolia*	Maple-leaved sycamore
Tilia platyphyllos	European linden
Tilia ulmifolia	Elm-leaved linden
Ulmus campestris	English elm
Ulmus montana	Scotch elm
SMALL TREES OF FORMAL OUTLINE	
Acer campestre	English cork maple
Acer ginnala	Maple
Acer tataricum	Tartarian maple

Botanical name	Common name
Alnus glutinosa	European alder
Alnus glutinosa var. *imperialis*	Cut-leaved alder
Alnus incana	Speckled alder
Aralia chinensis	Chinese angelica tree
Evonymus europaea	European spindle tree
Paulownia imperialis	Empress tree
Prunus cerasifera var. *atropurpurea*	Purple-leaved plum
Prunus Pseudo-Cerasus	Flowering cherry
Salix Caprea	Pussy willow
LARGE TREES OF INFORMAL OR PICTURESQUE OUTLINE	
Betula alba	European white birch
Carpinus Betulus	European hornbeam
Juglans Sieboldiana	Japanese walnut
Morus alba	White mulberry
Prunus avium	European sweet cherry
Quercus Cerris	Turkey oak
Quercus pedunculata	English oak
Zelkova acuminata	Zelkova
SMALL TREES OF INFORMAL OR PICTURESQUE OUTLINE	
Ailanthus glandulosa	Tree of heaven
Broussonetia papyrifera	Paper mulberry
Evonymus Bungeana	Bunge's spindle tree
Magnolia Soulangeana	Soulange's magnolia
Koelreuteria paniculata	Varnish tree
Pyrus baccata	Siberian crab
Pyrus floribunda	Flowering crab
PENDULOUS OR WEEPING TREES.	
Betula alba var. *pendula laciniata*	Cut-leaved weeping birch
Morus alba var. *tatarica pendula*	Tea's weeping mulberry
Salix babylonica	Babylonian weeping willow
Salix babylonica var. *dolorosa*	Weeping willow
Salix elegantissima	Thurlow's weeping willow
Salix Caprea var. *pendula*	Kilmarnock weeping willow
Sophora japonica var. *pendula*	Weeping sophora
TREES OF PYRAMIDAL OR CONIC FORM.	
Alnus japonica	Japanese alder
Ginkgo biloba	Maidenhair tree
Populus alba	White poplar
Populus alba var. *Bolleana*	Bolle's poplar
Populus alba var. *nivea*	Poplar
Populus nigra var. *italica*	Lombardy poplar
Populus Sieboldii	Japanese poplar

This concludes the series on "Hardy Exotic Plants Suitable for the Gardens of Missouri and Adjoining States," and, in connection with the series on "Native Plants" published in Volume 8 of the BULLETIN, covers the entire list of plant materials suitable for the gardens of this section of the country.

NOTES

On November 26 the biology section of the Central Association of Science and Mathematics Teachers, then holding a convention in St. Louis, met in the lecture room at the Garden where Dr. George T. Moore, Director of the Garden, gave an address on "Science Teaching and the Missouri Botanical Garden." After the lecture the visitors were conducted through the building and grounds by special guides.

Dr. George W. Freiberg, formerly Rufus J. Lackland research fellow at the Garden, now research bacteriologist, Commercial Solvents Corporation, Terre Haute, Indiana, spent several days at the Garden recently, working in the laboratory and library.

Recent visitors to the Garden include Dr. D. T. MacDougal, Director Botanical Research of the Carnegie Institution of Washington, Tucson, Arizona, November 18; Professor W. L. Eikenberry, professor of botany, University of Kansas, November 26; and Professor G. W. Hunter, professor of biology, Knox College, Galesburg, Illinois, November 26.

STATISTICAL INFORMATION FOR OCTOBER, 1921

GARDEN ATTENDANCE:

Total number of visitors	18,210

PLANT ACCESSIONS:

Total number of plants received in exchange	5
Total number of plants received as gifts	919

LIBRARY ACCESSIONS:

Total number of books and pamphlets bought	26
Total number of books and pamphlets donated	104

HERBARIUM ACCESSIONS:

By Gift—

Armeisa, Dr. P. C.—*Eupatorium incarnatum* Walt. from Arkansas	1
Blackford, Mrs. E. B.—Fungi of Massachusetts	2
Clokey, Ira W.—Senecios of Colorado	18
Deane, Walter—Plants of New England, collected by Hon. Joseph R. Churchill	96
Drushel, J. A.—Plants of Vermont and New York	10
Kauffman, Dr. C. H.—*Naematelia nucleata* Schw.	1
Leeper, Burt—*Thelephora cuticularis* Berk.	1
Rosen, H. R.—Fungi of St. Louis County, Missouri	2
Walker, Prof. L. B.—*Endogone argentina* Speg. from Nebraska	1
Botanical Department, Adelaide University, by Prof. T. G. S. Osborn—*Isoetes Drummondii* R. Br. from South Australia	3
Total	135

The Garden is open to the public every day in the year, except New Year's, Fourth of July, Labor Day, and Christmas—week days from 8:00 A. M. until one-half hour after sunset; Sundays from November to April, 1:00 P. M. until sunset, from April to November, 2:00 P. M. until sunset.

The main entrance to the Garden is located at Tower Grove Avenue and Flora Boulevard, on the Vandeventer Avenue car line. Transfer south from all intersecting lines.

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MISSOURI BOTANICAL GARDEN BULLETIN

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GERMINATING COCOANUT (COCOS NUCIFERA).

Missouri Botanical Garden Bulletin

Vol. IX St. Louis, Mo., December, 1921 No. 10

THE COCOANUT PALM

On account of its varied products the cocoanut (*Cocos nucifera*) is the most important of all cultivated palms. It is estimated that the world's output of the two cocoanut products, copra and coir, before the late war, was 50 per cent greater than that of rubber and only 40 per cent less than that of gold. The cocoanut is widely cultivated near the sea in all tropical countries where the average temperature is 70° F. and where there is no great variation in temperature between seasons. Owing to the thick fibrous outer covering of the fruit the entire nut will float and retain its power of germination for a considerable time, which no doubt has been a factor in its distribution along seashores. As its nearest relatives are all native of America it is believed, despite its very wide geographical distribution, that the cocoanut palm is of American origin. However, it is said to be indigenous to the Cocos or Keeling Islands of the Indian Ocean and to have been carried westward in prehistoric times. It was cultivated in Polynesia and Malaya for an edible crop before its discovery by Europeans.

Uses and Products of the Cocoanut.—In tropical countries where the cocoanut is grown practically every part of the tree is used in some form by the natives. The roots are used as a medicine, particularly as an astringent, and are frequently chewed as a substitute for the betel or areca nut. They are also used in basket-making, being interwoven with fiber. The trunk, when mature, develops a very hard external covering which is used in native hut building and is occasionally exported for cabinet work under the name of porcupine wood. It takes a high polish and is recognized by its peculiar ebony-like streaks irregularly disposed over a reddish brown ground. The young leaves, particularly the leaf bud, is much sought

for as a vegetable or salad, and the mature leaves are put to many uses, such as mats, baskets, shingles for native huts, fences, clothing, and ornaments. The leaf-stalks or petioles are made into tool handles and when cut into short lengths and frayed at one end are used as brushes. The midveins of the leaves furnish a strong fiber which is very desirable for basket-making, strainers, and native fishing tackle. The large fibrous triangular-woven sheaths which surround the trunk and the base of the leaf stalks are cut into various shapes to form mats. The fibrous coverings of the flower spikes, when dried, are used as torches and when twisted and soaked in water are made into coarse rope.

The mature nuts enter into the composition of various native sweetmeats and curries. The water enclosed within the unripe fruit is a cool refreshing drink that is much appreciated in most tropical countries and constitutes the only available drinking water in some of the smaller oceanic islands. Cocoanut milk is prepared by grating the white meat, mixing it with water and subsequently straining the mixture through cloth, the so-called milk consisting of the oil in suspension with a little mucilage and sugar. It is extensively used in India as a substitute for cow's milk.

The cocoanut enters into the superstitions of the natives of the Malaya-Polynesian region. Murray tells of a tribe of cannibals, among whom it is not proper for the slayer to partake of his victim, this privilege being reserved for his companions, but he may eat the heart, if during the course of his meal, he sits on one cocoanut and balances himself with his feet on two others.

Toddy or Wine.—This drink is obtained from the unopen flower spikes, the method of collecting the sap differing with the country. In the Philippines the natives climb the trees, bend the flower spikes down gradually, and bruise or cut off the tip. The irritation produced by this repeated treatment results in a flow of sap from the wounded surface, and a bamboo tube or panahod is then suspended below to catch the liquid. This bleeding continues for about a month, each day a fresh slice of the flower being cut off to facilitate the flow. As much as six pints a day is sometimes collected from a single tree. The toddy may be used as a beverage when fresh, but it is usually allowed to ferment when it becomes a highly intoxicating liquor called palm wine. Toddy is a source of both sugar and alcohol. If sugar is to be obtained

care is exercised to keep the containers sterile, but if alcohol is desired the same bamboo tubes are repeatedly used without cleaning.

Desiccated Cocoanut.—Among the cocoanut-producing countries Ceylon exports the largest amount of the manufactured article which is in considerable demand in the confectionery industry. In preparation only the fresh nuts are used. The hard shell is removed by a hatchet or small-power circular saw and the husk or fibrous exterior covering is taken off by a steam-power revolving rasp. The hollow kernel is then cut in half, the water or so-called milk drained off, and the white meat shredded by a machine. It is necessary to dry the kernel immediately after shredding to prevent it becoming rancid. Sugar or starch is occasionally added to assist the drying process. The method of drying is either by spreading the shredded cocoanut upon iron tables heated from below by steam or by placing it in trays in drying rooms heated to 110° F. With either system it is necessary to agitate or stir the shredded nuts frequently. After being cooled gradually the cocoanut is packed in sealed lead-lined cans for export.

Copra.—Copra, the most important of the cocoanut products, is the dried meat of the mature fruit. The best copra is that produced from uniformly ripe fruit which has been allowed to mature upon the trees and collected upon falling to the ground. However, in common practice the natives climb the palms every three months to collect the nuts. To expedite climbing the natives cut notches at intervals up the trunk, but European planters will not permit this practice because the wounds leave the trees open to disease and ultimately a large number of palms are destroyed. The up-to-date method of collection is by the use of a rope or strap fastened around the hips of the collector and around the tree. The natives soon become expert in climbing by this method, especially when scaling the older trees which grow in a leaning position. The old story of harvesting the nuts by the use of monkeys is not altogether a myth, for in the Sunda Islands and in Sarawak the animals are trained for this operation and are even exported from Sarawak to the Straits Settlements.

The high value of copra is due to the oil it contains, one cocoanut of average size, with up-to-date methods of extraction, yielding 5½ ounces of oil and 3 ounces of dried oil meal. Methods of extracting the oil differ with the individual and the

country. The early method was to remove the outer covering by the aid of a sharp three-cornered iron mounted on a stick, this implement being used to a great extent at present by the natives of the Philippine Islands. After the removal of the husk the nut was split in two by a sharp blow with a heavy knife. The halves were then placed in the sun to dry and after the shrinking of the kernel the hard shell was readily separated. The early settlers pounded the meat into meal and placed it in vats of boiling water, the applied heat bringing the oil to the surface when it was subsequently skimmed off. With the advent of the American and European planters, special machinery was invented for the complete operation of oil extraction, from expelling the nuts from the fibrous husks to expressing the oil from the kernels. The copra is dried by either hot-air evaporators or the sun. The hard shells are separated by shrinkage. The kernel or meat is then milled, the resultant meal being strained and molded into cakes and submitted to a hydraulic pressure of several tons per square inch which expresses or squeezes the coveted oil.

The ultimate use of cocoanut oil is in the manufacture of soaps, candles, glycerin, salves, and lotions, and also as an adulterant in cod-liver oil. Before the recent war the oil was used in the manufacture of oleomargarine, the characteristic odor of oil being removed by treatment with alcohol and animal charcoal. Careful analyses show that the vegetable fats and oils from the cocoanut have a higher nutritive value than most present-day mixed butters, but, unfortunately, a prejudice exists against nut butter.

Germany, prior to the war, imported the major portion of the output of copra from tropical Africa, consisting of 109,000 tons. The export from the Philippines amounted to over 160,000 tons, practically all of which came to this country.

Coir.—This product is the fibrous outer covering of the cocoanut. Its quality depends upon the situation of the plantation and the time of harvesting the crop. Palms growing adjacent to the sea produce a finer quality of fiber than those grown in the inland regions. As the fiber becomes coarser upon the maturity of the fruit, it is better to collect the fruit before ripening. In preparing the coir, the fiber is removed from the nuts by the natives and placed in basket-work cages. It is then thrown in backwaters or pits containing brackish water and left for several months until it has become softened and easily separated from the non-fibrous matter. After

being dried, cleaned, and sorted, it is baled for export. This fiber was the old staple cordage material of the Polynesian region, and is remarkable for its lightness and elasticity, stretching 20-25 per cent without breaking. The finer fibers are used for spinning purposes, cocoanut matting, and brushes, and the coarser material is used as a substitute for horse-hair in upholstery. The dust or refuse is used as a growing medium in forcing bulbs in hot-beds and propagating houses. As much as one ton of coir fiber is obtained from 12,000 cocoanuts.

Propagation.—For propagation purposes cocoanuts should be selected from palms 25-30 years old showing a good yield, and large nuts which have ripened upon the tree and fallen to the ground are best. Seeds picked green and forcibly ripened invariably decay, as do also those filled with milk, the best for germination being those which are only half filled. These selected nuts will be viable for twelve months. The seeds are sown in rows in specially prepared seed-beds of sandy soil and kept constantly moist and under cultivation. Under this treatment they will germinate within three months. The young shoot starts growing from one of the eyes at the rounded end of the nut (pl. 30) and before making its appearance has to penetrate the strong fibrous husk. From the seed-beds the strongest seedlings are transplanted into nursery rows spaced 3-6 feet apart. During this operation great care is necessary to prevent the breaking of the attached kernel which consists of reserve food supply for the young seedling. After three years in the nursery the plants are ready for permanent planting in the plantation, being spaced about 30 feet apart. The average yield under expert care varies from 50 to 75 nuts per tree annually, but it may be as high as 150-200 nuts per tree.

Cocoanut palms are not grown commercially in the northern states owing to their comparatively slow habit of growth. Specimen plants are seen only in botanic gardens or rare private collections. In Florida and California they are often grown for ornamental purposes. Large numbers have naturalized themselves along the seashores of Miami and Palm Beach where they produce an abundance of fruit, the fallen nuts germinating without attention. If mature nuts are obtained it is possible to raise young plants in greenhouses in this latitude. The nuts should be half embedded in the sand bench of the propagating house where a bottom heat

of 90° F. is maintained, and kept fairly moist. Upon germination the entire seed or nut should be potted in sandy soil. Care should be taken to bring the soil merely to the base of the shoot, as there is a tendency to damp off if planted too deep. Further transplanting is governed by the rapidity of growth. Unless the temperature of the greenhouse is kept at 70° F. it is useless to attempt the artificial cultivation of the cocoanut palm.

THE AFRICAN OIL PALM

The African oil palm *(Elaeis guineensis)* is indigenous to the western portion of Africa where it is found growing in the open valleys within two hundred miles of the coast. It will not thrive in dense forests but is frequently found associated with low undergrowth. The tree is very slow-growing and is 120 years old before its maximum height of 60 feet is attained. Mature plants have a very strong trunk, the upper part of which is clothed with coarse fiber. The leaves forming the crown or head often are 20 feet long. The fruit is borne in bunches which are called cones or hands. The flowers are very small and cream-white in color, the different sexes being borne on separate flower spikes. On young trees these spikes are small and produced in great numbers, but as the tree increases in age they become much larger and less numerous. For many years the planting of the oil palm was one of the first acts of the African natives upon settling on virgin ground, and as the trees were never cut down when they left for other regions the number increased from year to year. The natives valued the palm for its oil-yielding seeds and for the fiber surrounding the trunk, while the leaves were used in making cordage, mats, etc., and the midribs were supposed to keep off insects from the body.

During the St. Louis World's Fair arrangements were made by the Garden with Mr. S. P. Verner to collect rare African plants after taking the pygmies back to their native home in the Congo region. In 1906 Mr. Verner returned to the city with a large collection of plants and seeds, among which the African oil palm was identified upon its germination in the propagating houses. On account of the crowded condition of the greenhouses at that time growth of these young plants was extremely slow at first. In 1913 they were still in six-inch pots, with leaves two feet long. With the completion of the palm house these small specimens were

COCOANUT PALM GROWN IN FLORIDA.

AFRICAN OIL PALM (ELAEIS GUINEENSIS).

planted directly in the ground, and their remarkable development since then is shown by their subsequent growth compared with that in their native habitat. The large specimen towers 20 feet in height and bears compound leaves 16 feet long. The pinnules or leaflets measure 2 feet in length and are arranged alternate at the base and opposite toward the apex. The large petiole or stalk is triangular and covered with a mealy pubescence at the basal portion. The trunk measures 5 feet in height, 1½ feet in diameter at the base and tapers toward the top. It is covered with a dark brown fiber which gradually decays, leaving the dark green bark exposed. In general habit the plant suggests the date palm but the leaves are flat and not grooved as in the latter. The specimen planted adjacent to the west exit of the palm house produced its first flowers in August. Both spikes were staminate and consisted of many-branched spikelets which were covered with small creamy blossoms with an extremely strong and pleasant odor.

Before the late war the importance of this oil-yielding palm was not generally appreciated. That Germany fully realized its possibilities, however, is shown by the fact that during the years 1912 and 1913 her average annual import of palm kernels amounted to 248,000 tons. The British and French governments have now awakened to the importance of this palm and have established government experiment stations to assist the planters. Under cultivation palms 10 to 30 feet high will produce seven cones or bunches per year and with full production ten cones will sometimes result. A record bunch weighed fifty-six pounds, yielding 1445 serviceable oil nuts. Where a plantation is under expert supervision the trees are planted 25 feet apart, aggregating 67 trees per acre. The average yield would be between 536 and 670 bunches in the eighth year of planting. By European methods of extraction the yield of oil would be 1-1½ tons per acre exclusive of that from the kernels. The quantity of kernels obtainable from each tree varies from 26 to 35 pounds.

Palm Oil.—To collect the fruit the natives climb the trees in the same manner as described for collecting cocoanuts. The crowded seeds are about the size of a large olive and are surrounded by an orange-yellow outer covering or pericarp. This outer integument contains 60 per cent by weight of oil, and as this part is 40 per cent of the whole fruit the fruit is about 24 per cent oil. When the seeds are freed from

the cone they are placed in the sun for a few days, then stacked in piles and covered with leaves for several days until partially fermented so as to release the fibrous cases. In consequence of this fermentation the glycerin, which in fresh fruit constitutes 1 per cent of the palm, is reduced to .5 per cent, thus producing a serious loss in market value. To obtain the oil the natives boil the pericarp in water and skim off the released oil which rises to the surface. After coagulation it is an orange-red color of the consistency of butter and with a sweet violet odor when fresh. It is sometimes eaten by Europeans residing in Africa.

Organized efforts are now being made to overcome the wasteful native method of recovering the yellow oil from the seed covering and to supply American and European countries with a higher grade of oil than that of the variable uncertain product formerly shipped by the West African natives. One of the most up-to-date power machines for the preparation of palm oil removes the pulp from the nuts and subsequently presses it. This is known as the Calidonian dry process. The process of depericarping is effected by a machine patented by Mr. H. G. Fairfax, of England, which differs from most existing processes in the absence of steaming or boiling the pulp in water before expressing the oil. It is claimed that by this method neither the fruit nor oil come in contact with water, so that even if fatty acid and glycerin occur in over-ripe fruit no glycerin is lost.

Palm Kernel Oil.—This oil is white in color and softer than that which is obtained from the outer covering of the seed. It is obtained either by crushing the seed at the mill or by chemical extraction. Formerly, palm kernel oil was employed in the manufacture of soap, candles, etc., but at the present time it is in great demand by the makers of nut butter, chocolate fats, etc. Before the recent war Germany controlled the kernel export to such an extent that she imported the kernels from Liverpool, England, and then sent the expressed oil back to the same port at a lower price than that manufactured by the English merchants. Now, however, that the British have control of the German West African colonies, one of the largest firms for manufacturing palm kernel oil has installed its own steamers for the purpose of bringing seeds from Africa to Liverpool. During 1917, 58,000 tons of kernels were exported from Sierra Leone and 250,000 tons from West Africa.

In packing the seed for export great care is necessary to prevent overheating and subsequent combustion. Recently a fire in the hold of a ship being loaded at Nigeria was traced to combustion of sacks of palm kernels. They had been packed and stored for some time during the dry season and placed in the blazing sun for a few days previous to loading. These conditions caused the partial exuding of oil which was readily absorbed by the extremely dry sacks when loaded in the hold of the ship, causing combustion. The investigation also showed that the fire started at the outside of the sacks, not inside among the kernels, and the partially burned sacks still held from 20 to 25 per cent oil.

Palm Kernel Cake.—In the early days of importation the residue of the palm after expressing the oil, called palm kernel cake, was discarded as useless. The Germans discovered that when it was fed to milch cows the amount of butter fat was increased ¼ per cent, thus making it possible to get as much butter from nine cows as it formerly took ten cows to produce. Experiments carried out by an English firm which now uses large quantities of seeds proved that returns are equally as good from the use of palm oil cake as from linseed cake or decorticated cotton-seed cake. For the purpose of this experiment 30 head of cattle, 18 heifers and 12 bullocks, all cross-bred 2-year-olds, were used. These were divided into three lots of ten each, each experiment employing 6 heifers and 4 bullocks. Prior to the experiment the cattle were subjected to a preparatory period of feeding in order to accustom them to experimental foods. During the trial No. 1 was fed with linseed cake, No. 2 with decorticated cotton-seed cake, and No. 3, with palm kernel cake. The cakes were also fed in mixture with locust-bean cake or meal. The experiments covered 84 days, which was divided into three periods of 28 days each, the animals being weighed at the beginning and again at the end of each experiment. The final conclusions were:

"1. Fed in the same quantities, palm-kernel cake may be expected to give equally as good a return in live weight increase as linseed cake or decorticated cotton cake, and at present prices it gives a better monetary return than either of these.

"2. Fed in mixture with locust-bean meal it is taken readily by stock, and no difficulty need be experienced in

storing cake containing a comparatively large percentage of oil."

A WOOD-THRUSH NEST IN THE ECONOMIC HOUSE

Birds not infrequently build nests in the taller trees and shrubs growing within the conservatories at the Garden. There were probably a dozen or more nests in the economic house, palm house, and cycad house during the past summer. The following communication from Mr. Otto Widmann is of particular interest, however, since it records the rearing of the young of the wood-thrush, a bird regarded as being unusually shy, in the economic house.

"Do you know that there is the nest of a wood thrush (*Hylocichla mustelina*) in the economic house, and that three young ones were successfully reared in the nest, though thousands of visitors must have passed within a few feet of it. The nest is in the triple fork of a candleberry tree, *Aleurites triloba*, twelve feet from the ground, and the only access the birds had to it was through the ventilators kept open in summer.

"This is a most interesting example of the power of accommodation in birds. In the works of the pioneer ornithologists we find the wood thrush described as a shy woodland bird. Fifty years ago Dr. J. A. Allen referred to several instances 'where the wood thrush did not show itself to be such a recluse as many describe it.' Twenty-five years ago the species had become a common denizen of our parks and suburban gardens, sometimes making its nest within a few yards of occupied houses. At that time and for a number of years a pair of wood thrushes built its nest in one of the lowest branches of two European maples in the Arboretum at its entrance where hundreds of people passed and where many stopped for rest on a bench under the maples. But now in the summer of 1921 we find that a pair had the courage and confidence to enter the Conservatory itself, build its nest in a tropical tree and raise its young undisturbed by the daily work of the attendants and the passing of throngs of visitors. We may expect the birds to return to the same place next summer."

NOTES

Mr. G. H. Pring, Horticulturist to the Garden, was re-elected president of the St. Louis Association of Gardeners at its December meeting.

Mr. G. H. Pring lectured before the St. Louis Aquarium Society, December 13, on "Aquatic Plants, Including Those Adapted to Aquaria."

Dr. George T. Moore, Director of the Garden, discussed the Missouri Botanical Garden and botany in the symposium on "What Has Missouri Done for Science in Its One Hundred Years of Statehood?" before the science section of the Wednesday Club, November 30.

Visitors to the Garden during December include Professor Walter B. Kelly, professor of agricultural chemistry, University of California (Citrus Experiment Station), Riverside, California; Dr. and Mrs. G. W. Groff, the former, director of agricultural work, Canton Christian College, Canton, China; Dr. Charles Brooks, pathologist, Bureau of Plant Industry, United States Department of Agriculture; Professor William G. Fearnsides, professor of geology, University of Sheffield, Sheffield, England.

The annual banquet of the Board of Trustees of the Missouri Botanical Garden will take place December 28 at the Jefferson Hotel on the occasion of the meeting of the American Historical Association in St. Louis. Chancellor Frederic A. Hall, a member of the Board of Trustees of the Garden, will preside, and the president of the American Historical Association, Jules Jusserand, Ambassador of the French Republic, will deliver his presidential address on "The Rearing of Ambassadors."

The display of orchids at the Garden will be installed about the first of January and will continue throughout the months of January, February, and March. During these months the floral display house will be converted as nearly as possible into a tropical forest in order to represent the natural habitat of orchids. This is the first time this method of display has ever been used in this country. Orchids will be shown growing upon trees as they are to be found in the forests of South America, and terrestrial forms will be planted as undergrowth, shaded by the trees above. The Missouri Botanical Garden, which includes the D. S. Brown collection, is reputed to be the best and largest of its kind in the country.

STATISTICAL INFORMATION FOR NOVEMBER, 1921

GARDEN ATTENDANCE:

Total number of visitors	99,856

PLANT ACCESSIONS:

Total number of plants received in exchange	3
Total number of plants received as gifts	3

LIBRARY ACCESSIONS:

Total number of books and pamphlets bought	28
Total number of books and pamphlets donated	102

HERBARIUM ACCESSIONS:

By Gift—

Aiken, Walter H.—Specimen of cycad from Honduras	1
Bresadola, G.—Fungi of North America	3
Drushel, J. A.—Plants of Vermont and Missouri	5
House, Dr. H. D.—Fungi from N. Y. State Mus. Herb.	65
Payson, Dr. E. B.—*Pinus* sp. from Wyoming	1
Povah, Professor A. H. W.—*Septobasidium pseudopedicellatum* Burt	1
Pring, George H.—*Ulmus americana* L. from Missouri	1
Rose, Dr. J. N.—Photograph and drawing of *Echinocactus Sileri* Engelm	2
Rosen, H. R.—*Geaster Morgani* Lloyd	1
Stewart, Dr. F. C.—*Hydnum Erinaceus* Bull	1

By Exchange—

Schonland, Dr. S.—*Isoetes Wormaldii* Sim from South Africa	3
U. S. National Museum—Miscellaneous cryptogams	90
Total	174

The Garden is open to the public every day in the year, except New Year's, Fourth of July, Labor Day, and Christmas—week days from 8:00 A. M. until one-half hour after sunset; Sundays from November to April, 1:00 P. M. until sunset, from April to November, 2:00 P. M. until sunset.

The main entrance to the Garden is located at Tower Grove Avenue and Flora Boulevard, on the Vandeventer Avenue car line. Transfer south from all intersecting lines.

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